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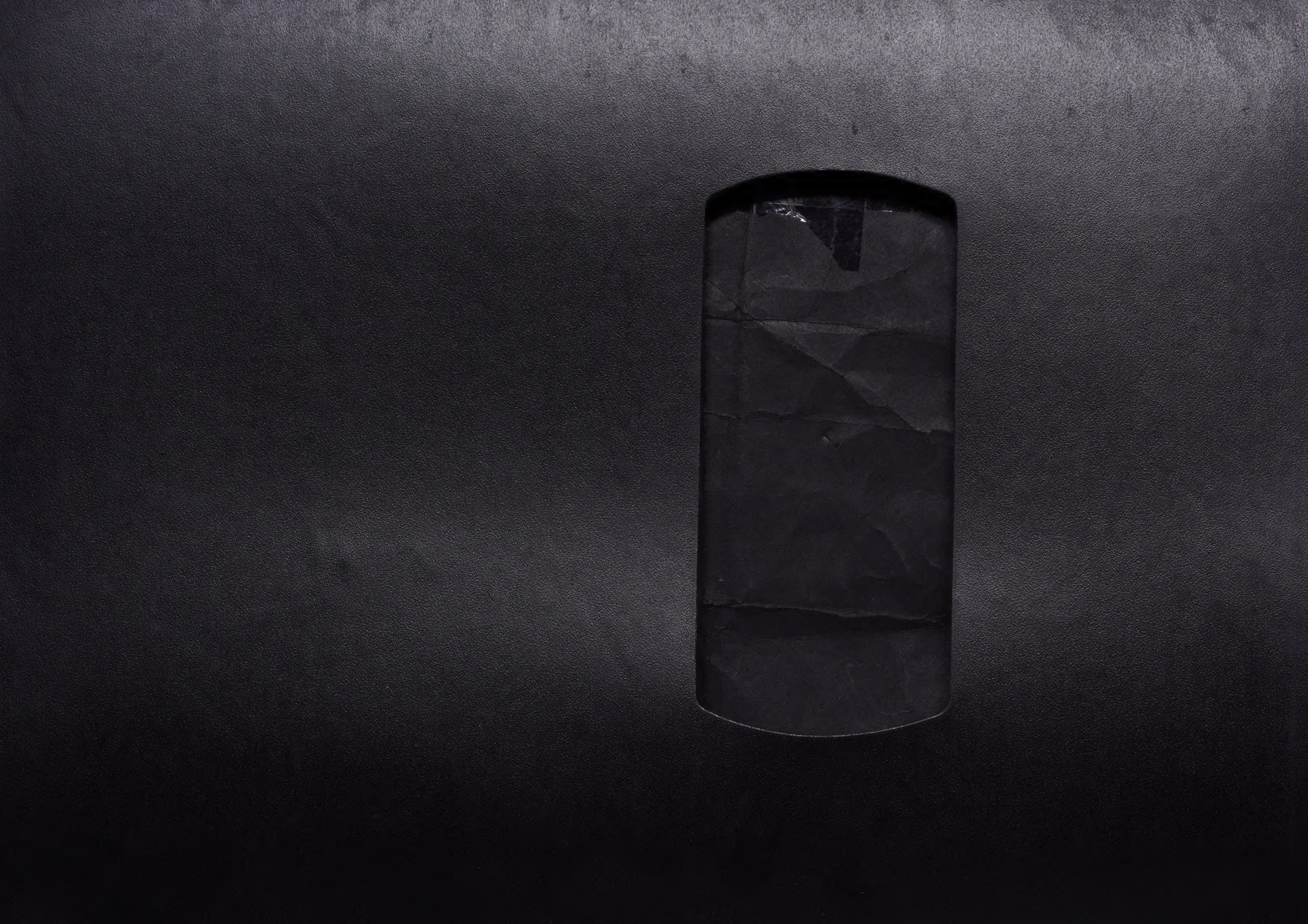

PURPOSE OF MANUAL

The purpose of this manual is to serve as a primary source of basic information on General Electric TRS-696B Solid-State 6-8 GHz Microwave Equipment.

Instructions and drawings for the TRS-696B Microwave Equipment are compiled in four major chapters:

1. GENERAL DESCRIPTION
2. INSTALLATION CHECKOUT
3. PERFORMANCE CHECKOUT
4. PRINCIPLES OF OPERATION, MAINTENANCE, DRAWINGS AND PARTS LISTS

The first three chapters contain information for the TRS-696B Microwave Equipment operating as a system. The fourth chapter contains instructions on the individual units in the system, providing principles of operation, maintenance, drawings and parts lists.

Chapter 4 is divided into sections such as transmitter, receiver, power supply, etc. All units associated with the transmitter, receiver, etc., are contained in the associated section.

Unit Instructions are divided into three categories of information.

A. Description
B. Specifications
C. Circuit Description
D.

Drawings are identified by numbers prefixed by single or double lette such as C-5496997 or DD-5496285, or by a number and letter prefix such as 19C300432. Several classes of drawings are used in this manual.

A. Installation Diagrams: provide rack dimensions for station assembly.

B. Interconnection Diagrams: provide information for shelf, rack and inter-rack connection.

C. Elementary Diagrams: provide information on internal circuitry of individual units. Each electrical component is identified by a symbol which is listed in the associated Parts List.

D. Service Outlines: provide outline of unit showing location and identification of major components. Where applicable voltages, signal levels or waveshapes are included for maintenance references.

INSTRUCTION REVISIONS

Changes to an instruction are indicated by a revision letter following the publication number; i.e., LBI-1538A would indicate that the instruction has been changed once since it was originally issued.

PRODUCTION CHANGES

A production change on a unit is designated by a revision letter following the unit identification number. The revision letter indicates the number of production changes made on the unit. PL-5499958, REV. A indicates a single production change has been made on the unit. REV. B indicates two changes. Any given revision will always include all previous changes.

SOLID-STATE MICROWAVE RADIO EQUIPMENT
BASIC

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TRS-696B RADIO RELAY EQUIPMENT (SOLID STATE)
PSIT FREQUENCY BAND
BASIC CONFIGURATION

FUNCTION

The TRS-696B radio relay equipment provides point-to-point communication in the Public Safety, Industrial and Transportation (PSIT) frequency band. It provides for medium route transmission/reception of up to 600 telephone channels or data and facsimile information of equivalent channel loading. Single sideband (SSB) techniques are utilized in terminal and remodulating type repeaters to provide system performance which meets CCIR and AT & T transmission/reception objectives up to 420 channels for PSIT frequency band. The FCC bandwidth limitation of 10 MHz limits the rf system to 420 channels without a pilot, or 300 channels with a 2.1 MHz pilot, each with normal 200 kHz deviation, or to 600 channels with underdeviation.

EQUIPMENT DESCRIPTION

The equipment consists of a single transmitter-receiver combination, power supply and associated metering and baseband interconnect components. The transmitter-receiver combination is connected through a waveguide duplexer assembly to the antenna waveguide stack. The solid state transmitter and receiver provide low power consumption while maintaining high gain bandwidth features. The transmitter utilizes a solid state RF oscillator, RF power amplifier and RF multiplier and has a capability of providing in excess of 1 watt of output power. Transmitter frequency stabilization is provided by means of crystal automatic frequency control (AFC) circuits. The receiver is a superheterodyne type with AFC and automatic gain control (AGC) circuits and a built-in waveguide fade simulator.

A low power transmitter is available which omits the RF power amplifier for applications not requiring maximum system gain.

A built-in waveguide fade simulator is available as an optional item; it consists of a variable calibrated waveguide attenuator. It can be used to measure system fade margin or to simulate a fault condition during receiver test and maintenance. The fade simulator has a negligible insertion loss and incorporates a spring-loaded return-to-zero attenuator to remove attenuation after tests are completed.

The power supply consists of a time-ratio controlled regulator and dc-to-dc converter. It receives input power from a 48 volt (nominal) station battery with positive ground; 24 volt operation is available as an option. The power supply furnishes the voltages (-24 Vdc, +24 Vdc, +26 Vdc, -32 Vdc and +4 Vdc) required for operation of the transmitter and receiver.

The rack meter and associated selector switch is located on a meter door. The selector switch is interconnected with the transmitter and receiver function selector switches to monitor functions relative to their operation.

Transmit and receive baseband matching pads are installed in rack shelves adjacent to the transmitter and receiver. The baseband pads (adjustable in 1/2 dB steps) provide the correct baseband levels to and from the associated multiplex or other equipment. Normal per-channel transmitter baseband input level is -42 dBm and normal per-channel receiver baseband output level is -20 dBm. Continuity pilots are added to the baseband at a level of -3 dBm0.

The waveguide duplexer is a three-port device with a microwave energy circulator to provide isolation between transmitter and receiver radio frequency circuits. The duplexer assembly provides a path for radio frequency energy from the transmitter to the antenna stack and a path for received radio frequency energy from the stack to the receiver.

The antenna waveguide stack provides the interconnection for transmit and receive energy to and from the duplexer assembly and the common antenna. The waveguide stack may include a power coupler (optional item) which is used for test and maintenance purposes.

RACK DESCRIPTION

The basic rack arrangement is shown in Figure 1. Shallow depth racks (13.5 inches) of various heights (7, 8 and 9 feet) and hinged swing-out front of rack doors and panels (individually removable) are used to mount the equipment. The construction permits front access to all assemblies, coaxial cabling, rack power and signal wiring and rack waveguide components. The racks may be arranged to suit any station floor plan; back-to-back, side-by-side or flush-mounted to walls. The waveguide runs, baseband signal and alarm connections are brought out at the top of the rack. The baseband signal and alarm connections are made through the interconnect shelf near the top of the rack. Dc power input connections from the station battery are brought in at the bottom of the rack.

The transmitter shelf is designed to accommodate the composite RF generation and waveguide components of the transmitter, as well as the transmit baseband amplifier. The receiver shelf accommodates the composite waveguide components of the receiver. The interconnect shelf and the meter shelf are arranged in upper and lower compartments with provision for plug-in modules in their respective lower compartments. The upper compartments of these two shelves usually have passive devices located on them.

Door assemblies for the transmitter and receiver consist of a front panel outer door and an inner door section. The function selector switch and fault indicator lamp circuits are installed on the front panel outer door. The inner door section is hinged and held by snap-in's to the inside of the outer door. The transmitter inner door section houses the AFC amplifier and control panel, and a fault sensing plug-in module (when the sensing option is selected). The AFC amplifier and control panel are located on the bottom position and the fault sensing module occupies the upper portion of the inner door. The receiver inner door section houses the IF amplifier/discriminator, AFC amplifier and control panel on the shelf side and houses the noise detector and fault sensing module (optional item) on the outer door side. The interconnect shelf is provided with a blank door (panel). The meter door houses the rack meter and selector switch that provides centralized metering of transmitter and receiver operational functions.

Waveguide runs from the transmitter and receiver to the top of the rack are arranged on the right hand side (front view) of the rack. The duplexer assembly location will vary depending upon rack height and the specific frequency band of service.

Rack power cabling originates from the power supply at the bottom of the rack and is arranged on the left front side of the rack. Individual power connectors from the rack power cable mate with power jacks on the hinged door assemblies of the transmitter, receiver and meter shelves. The interconnect shelf terminal board receives -24 Vdc and -48 Vdc from the power supply and the station battery input terminal, respectively. When a 24 volt station battery is used, an optional converter provides -48 Vdc to the interconnect shelf.

ALTERNATE EQUIPMENT

Two general purpose alternate equipment selections are available for TRS-696B rack-ups. These are (1) the alarm relay panel, and (2) rack heights. The requirements of the user dictate which of the two general purpose alternates is of primary importance to the operating system. In general, alarm relay circuits and rack heights will depend on whether fault alarm indicators and extra rack space are needed.

OPTIONAL EQUIPMENT

A number of optional items of equipment are provided for TRS-696B basic equipment rack-ups. The user may select to include in the equipment rack-up (1) no optional items or (2) one or more optional items depending upon specific requirements. A number of optional items may be added as a field installation item to the equipment rack-up. A summary of the optional items and their function is given in succeeding paragraphs.

SERVICE CHANNEL UNIT: The service channel unit is used for order wire service, party line maintenance communications and fault or control communications. The unit operates completely independent of the multiplex equipment, occupying the baseband spectrum below the multiplex frequency allocations. Three types of channels are provided for service channel functions: tone channels, a direct voice channel and derived voice channels. The tone channels are typically used for status reporting, especially in relation to alarm systems for the radio equipment. The tone channels are also used for telegraph and telemetry systems. The direct voice channel is used primarily for maintenance and related functions. The derived voice channels will be similar to conventional multiplex channels in the 60-108 kHz spectrum. The four channels may occupy any of the twelve 4 kHz slots in this spectrum. The service channel can be equipped with accessories (optional) to meet a variety of requirements. These accessories include handset, headset and monitor amplifier features.

ALARM PANEL: Two different type of alarm panels are available for basic system rack-ups, a basic alarm panel and a two-function alarm panel. The basic alarm panel provides connections for the service channel unit, fusing for auxiliary equipment and provision for the addition of alarm relay outputs. The two-function alarm includes two relays used in conjunction with the sensing option to provide for both equipment and path failure alarms.

FAULT SENSING: Continuity pilot and fault sensing equipment provides for detection of path continuity and equipment failure. The functions which are monitored by the fault sensing circuits are (1) system continuity (presence of continuity pilot signal), (2) transmitter power and (3) receiver local oscillator failure (mixer current function), (4) receiver noise fault. Alarm indications and alarm outputs to the optional alarm panel are provided.

POWER COUPLER: A waveguide cross coupler installed on the antenna waveguide stack at the top of the rack provides 30 dB of calibrated decoupling (25 dB for the low power option). Its primary function is to facilitate power output and receiver sensitivity measurements during test and maintenance procedures. The cross coupler has a circular waveguide output flange.

FADE SIMULATOR: The fade simulator consists of a variable calibrated waveguide attenuator. It is used to measure system fade margin or to simulate a fault condition during receiver test and maintenance. The fade simulator has a negligible insertion loss and incorporates a spring-loaded return-to-zero attenuator which insures against attenuation remaining in the system after tests have been performed.

ISODUPLEXERS: The isoduplexer provides an additional 20 dB of isolation when installed on the transmitter and receiver ports of the duplexing circulator. The isoduplexer provides for improved performance when long waveguide antenna runs are used. In general, the transmission equipment noise (echo feeder distortion) generated in transmission lines and antennas which relates to the VSWR is improved by the addition of isoduplexers.

BLANK PANEL/DOORS: Blank panels or doors are used to cover unused shelf areas. These optional items are primarily used to achieve a smooth front-of-rack appearance. The blank doors are hinged to swing-out and the blank panels are secured on the rack by friction clips.

117 VAC OPERATION: The TRS-696B is designed for station battery operation, however, operation from regular commercial power is utilized by means of an ac/dc converter. The ac/dc converter consists of rectifier and filter circuits which supply the dc voltage to the rack power supply.

AC OUTLET/VENT: The ac outlet option consists of a utility box containing two ac outlets and is located on a shelf above the power supply. Provision is made for external connections from the ac source. The vent options consists of a hinged vent swing-out cover for the utility shelf.

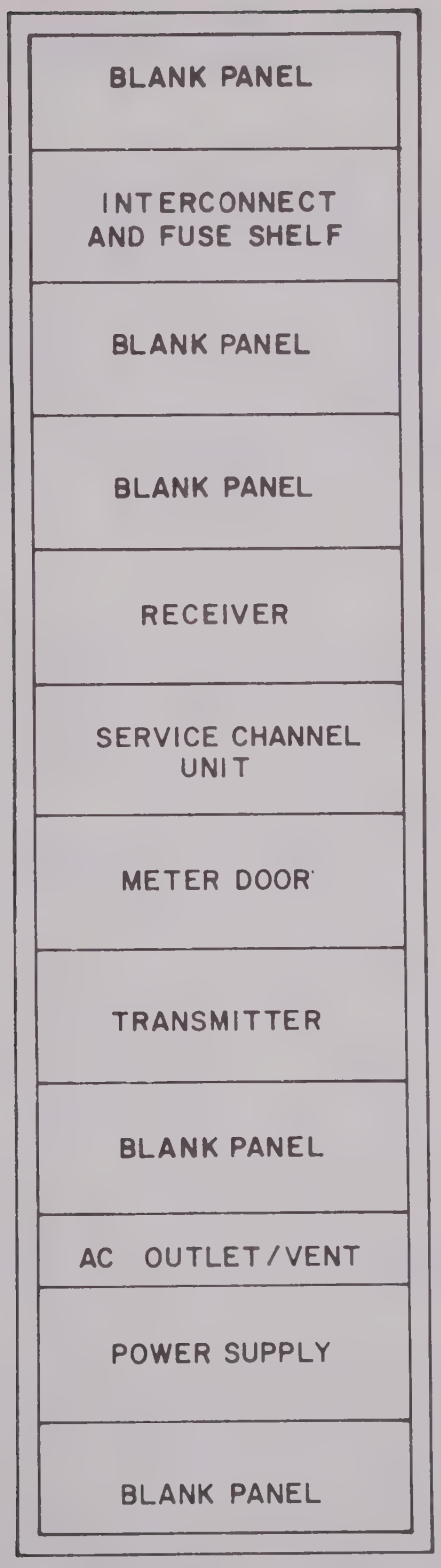

Figure 1. Basic Rack-Up (Typical)

CRYSTAL AFC OFF-FREQUENCY ALARM: Provides an alarm indication if the transmitter drifts ±1 MHz from its assigned frequency. It is a field installable item.

-24 VOLT POWER SUPPLY: A power supply designed to operate from a -24 volt source and supply all the regulated voltages required in a TRS-696B rack, is offered as an option for all TRS-696B rack configurations. It is offered as a factory installed option only. System performance is not affected, but rack power consumption will increase by 10-20 watts.

24 TO 48 VOLT CONVERTER: If -24 volt operation is chosen, a 24-to-48 volt converter is offered as a factory installed option to provide the unregulated -48 Vdc required to operate the optional service channel and/or radio LD multiplex equipment. It is provided only when one or both of these options are used in a rack to be operated from a -24 volt source.

FREQUENCY ASSIGNMENTS

Basic equipment systems are assigned for operation in the PSIT (6575-6875 MHz) frequency band. As specified by the FCC regulations, the bandwidth limitations of 10 MHz limits the rf system to 420 channels without pilot, or 300 channels with 2.1 MHz pilot, each with normal 200 kHz deviation, or to 600 channels with underdeviation.

EQUIPMENT PERFORMANCE SPECIFICATIONS

Equipment performance specifications and other operational details are given in related sections (I through V) of this chapter.

DIMENSIONAL DATA

Rack Height	7, 8 or 9 feet
Rack Width	20.5 inches (19-inch EIA mounting)
Rack Depth	13.5 inches
Rack Unit	1 Rack Unit is 1.75 inches
Transmitter	5 Rack Units (high)
Receiver	4 Rack Units (high)
Meter Panel	4 Rack Units (high)
Power Supply	4 Rack Units (high)
Interconnect Shelf	4 Rack Units (high)

TELECOMMUNICATION PRODUCTS DEPARTMENT
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TRS-696B TRANSMITTER (PSIT SOLID STATE) CRYSTAL AFC OPERATION AND SPECIFICATIONS

GENERAL

The transmitters (Model UT-10-C high power and Model UT-10-D low power) transmit frequency-modulated (FM) signals in the 6 GHz frequency range and utilize a crystal reference method of frequency stabilization. The transmitter assembly consists of a solid state RF oscillator, RF power amplifier (in UT-10-C only), RF multiplier and associated waveguide components which include a crystal reference AFC circuit, an AFC amplifier and control panel, a baseband amplifier and a sensing unit (optional item in basic configuration). Separate transmit baseband and service channel (optional item) inputs are provided. The baseband amplifier increases the baseband signal to the level required for modulation. The crystal controlled AFC circuits provide an error voltage (when the frequency drifts) that is used to return the RF oscillator to the assigned frequency.

OPERATION

The information to be transmitted is fed into the message input of the baseband amplifier through a transmit baseband pad. The service channel input is applied (through an amplifier) to a separate input of the baseband amplifier. When sensing equipment (optional item in the basic rack configuration) is a part of the equipment rack-up, a continuity pilot signal is added to the baseband signal. The continuity pilot signal is added at the output side of the baseband pad immediately following a pilot reject filter. The baseband amplifier increases the level of the composite baseband to the required modulation level. Modulation of the RF oscillator is accomplished by applying the baseband amplifier output to the modulating varactor in the RF oscillator. The modulated RF oscillator output is then applied to the harmonic absorber, an isolator, and the RF power amplifier (UT-10-C only). Amplifier output is applied to an isolator, followed by a times four multiplier. The multiplier output passes through a coax-to-waveguide transition. A power monitor (detector diode), located in the first section of waveguide, provides a dc voltage proportional to power level to the sensing unit. Next in the waveguide run is an isolator, a three-cell filter, a second isolator (omitted in basic) and the crystal reference AFC circuitry. The RF output of the AFC section passes to the antenna stack. Optional isoduplexers and/or power couplers may be installed in the rack waveguide arrangements.

The crystal reference circuit is actually an FM microwave receiver whose input signal is a sample of the transmitter output. The input from the waveguide isolator is mixed with a local oscillator signal (derived from the 360 MHz reference oscillator) to provide a 70 MHz IF frequency. The first stages of the 70 MHz IF circuit are gated by a squarewave signal and a gated 70 MHz reference signal is injected into the final stages. The combined effect is that one-half of the time, a signal is derived from the transmitter and the other half, the signal is from the 70 MHz reference source. If the two signals are the same frequency, there will be no output from the discriminator to the AFC amplifier. If the frequencies differ, a squarewave error voltage whose

amplitude is a function of the frequency difference is developed. The error voltage is compared in the AFC amplifier circuits to determine the magnitude and direction of the frequency error. The AFC amplifier output is applied to the RF oscillator tuning varactor to either increase or decrease the varactor voltage, depending on the direction of the error. When fault sensing is used, continuity pilot sensing is obtained from the crystal AFC. The fault sensing output gives a local check on the transmitter baseband amplifier, the solid state RF components and the crystal AFC unit. Another output of the crystal AFC is used to feed an optional AFC alarm circuit. When the error voltage output becomes equivalent to ±1 MHz off-frequency, the alarm circuit is activated.

TRANSMITTER SPECIFICATIONS

RF Power Output (minimum at rack flange):

	BASIC	STANDBY/SPACE DIVERSITY
UT-10-C without isoduplexer	+30 dBm	+29 dBm
UT-10-C with isoduplexer	+29.6 dBm	+28.6 dBm
UT-10-D without isoduplexer	+24 dBm	+23 dBm
UT-10-D with isoduplexer	+23.6 dBm	+22.6 dBm

Power Input:	
UT-10-C	37 watts
UT-10-D	22 watts
Frequency Stability:	±0.002%
Peak Carrier Deviation:	
420 Channels, no pilot	3.2 MHz
300 Channels, no pilot or 2.1 MHz pilot	2.75 MHz
600 Channels, 3.2 MHz pilot 6.7 dB underdeviation	1.8 MHz
420 Channels, 2.1 MHz pilot 1 dB underdeviation	2.9 MHz
Spurious Output Level:	63 dB below carrier level
Transmitter Filter Bandwidth (3 dB):	58 MHz minimum 61 MHz maximum

Power Consumption at 51.6 Vdc: (including Power Supply)

UT-10-C	55 watts
UT-10-D	40 watts

DC Voltage and Current Requirements:

	-32 Vdc	+26 Vdc	-24 Vdc	+24 Vdc
Transmit RF oscillator (includes transmit BB amplifier, RF oscillator and -32 volt regulator)	275 mA	0 mA	150 mA	0 mA
RF Amplifier	0 mA	600 mA*	0 mA	0 mA
Transmitter AFC	0 mA	0 mA	370 mA	0 mA
Transmitter Sensing	0 mA	0 mA	30 mA	5 mA
Transmitter Door	0 mA	0 mA	0 mA	0 mA
Total Current	275 mA	600 mA*	550 mA	5 mA

*Omit for UT-10-D applications

Baseband Specifications:

Input Level	-42 dBm to -10.5 dBm (1/2 dB steps)*
Input Impedance	75 ohms, unbalanced (nominal)**
Input Return Loss	30 dB minimum 300 Hz to 4.3 MHz (no sensing) 26 dB minimum 300 Hz to 4.3 MHz (with sensing)

*Refer to Section IV for emphasis specifications
**Refer to Section IV for impedance conversion options

Sensing Specifications:

Pilot Frequency	2.1 MHz, 300-420 Channels (PSIT) 3.2 MHz, 421-600 Channels (PSIT)
Pilot Frequency Stability	+0.005%
Pilot Level	3 dB below test tone level
Fault Level	6 dB drop in pilot level (nominal)
Pilot Filter Rejection	30 dB (PSIT)
Power Level Sensing	Fault Level, 4.5 dB (approximately) drop in carrier power

Service Channel Specifications

Frequency Band	300 Hz to 108 kHz
Frequency Response	+0.2 dB, 300 Hz to 108 kHz (single hop)
Transmitter Insert Level	715 millivolts rms (nominal)*
Impedance	17,000 ohms

Isolation from Baseband Input: >60 dB

*This level corresponds to the baseband test tone level. If the test tone deviation for the message baseband is set to 200 kHz rms, then the Service Channel deviation will be 200 kHz rms. The Service Channel output does not go through any preemphasis network which may be used. If the baseband signal is preemphasized, a pad in the baseband amplifier is connected to reduce the service channel level by 4 dB. (Refer to Section IV)

Crystal AFC Alarm Unit (option)

Input Signal	Squarewave (error voltage)
Input Impedance	10,000 ohms
Transmitter Off-Frequency (AFC ALARM option)	±1 MHz drift from assigned frequency

TELECOMMUNICATION PRODUCTS DEPARTMENT
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TRS-696 RECEIVER (EGC) OPERATION AND SPECIFICATIONS

GENERAL

The TRS-696 receiver is designed for reception of frequency modulated (FM) signals in the 6 to 8 GHz range of frequencies. It is a superheterodyne type which incorporates automatic frequency control (AFC) and automatic gain control (AGC) loops. The AFC circuits maintain the solid-state local oscillator at a constant 70 MHz frequency difference with respect to the received signal frequency. The local oscillator frequency is placed above the received carrier frequency when the receiver is operating in the upper half of the assigned frequency band and at 70 MHz below when operating in the lower half. The AGC circuits control the overall gain of the IF amplifier in accordance with the received carrier level.

OPERATION

The incoming signal from the antenna waveguide stack enters the duplexer assembly and is routed to the seven-cell preselector filter on the receiver shelf. The preselector filter rejects adjacent channel and image frequency interference. A fade simulator may be part of the isolator waveguide section. The fade simulator is a calibrated variable attenuator which is used to check path margin and receiver sensitivity. The signal output from the filter is passed through the fade simulator and continues through an isolator waveguide section which provides high attenuation to reflected signals from the receiver. The signal output of the isolator is passed into the receiver mixer diode circuit along with the local oscillator output. The local oscillator output is passed through an isolator, a variable attenuator and a single section filter into the receiver mixer circuit. The single section filter keeps signal energy out of the local oscillator circuitry. The receiver mixer provides a 70 MHz IF difference frequency output which is applied through an IF preamplifier section of the mixer waveguide, equalizer components (delay and slope) and an IF filter to the IF amplifier. The IF filter determines the IF selectivity and will either be a 15 MHz bandwidth filter or a 25 MHz bandwidth filter. Where channel loading is 420 channels or less, a 15 MHz bandwidth filter is used. For channel loading of more than 420 channels a 25 MHz bandwidth filter is used.

After amplification by the IF amplifier which includes an AGC loop, the regulated (constant output level) output is passed through a limiter to the baseband discriminator. The discriminator output is fed to a baseband amplifier. The discriminator also provides an output to the AFC amplifier for control of the local oscillator frequency. The AFC amplifier consists of a difference amplifier, a reference voltage source and a switching circuit. The input from the discriminator is compared to the reference voltage by the differential amplifier which produces an output voltage proportional to the difference between the discriminator input and the reference voltage. This output is used to tune the local oscillator so that a constant 70 MHz difference is maintained with respect to the incoming signal frequency. The switching circuit provides for turning the AFC on and off and for monitoring purposes during adjustment and operation.

The baseband amplifier provides an output to the receiver noise comparator. The noise comparator input is applied through a selective filter to a noise amplifier whose outputs are fed to the receiver baseband logic module and to the squelch circuit of the fault sensing module. When the noise level exceeds preset levels, squelch fault and noise fault gates are applied to operate the logic module and the fault sensing module squelch circuit. When the logic module turns off the baseband switch, the faulted receiver is disconnected from the baseband output terminal.

The receiver sensing module determines whether the receiver is operating correctly on the basis of inputs (mixer current, continuity pilot and squlech levels) from the receiver mixer, baseband switch and noise comparator circuits, respectively. The mixer current and pilot level inputs are sensed by a combined level detector and if either level drops below preset levels (while the receiver is unsquelched) a receiver fault lamp on the receiver door is turned on and a fault alarm relay in the interconnect shelf is activated. If the receiver is squelched as a result of a squelch gate output from the noise comparator, a pilot fault is inhibited and only a drop in mixer current level will cause a receiver fault indication. The receiver sensing module squelch circuit causes a squelch alarm light on the receiver door to turn on and a squelch alarm relay in the interconnect shelf to be activated when the squlech gate input is present. A squelched receiver returns automatically to service as soon as the noise level returns to acceptable level.

RECEIVER SPECIFICATIONS

RF PRESELECT FILTER

Bandwidth (3 dB):	32 MHz, minimum 45 MHz, maximum

RF ISOLATOR

Attenuation:	0.5 dB or less (forward) 20 dB or more (reverse)

INTERMEDIATE FREQUENCY

IF Frequency:	70 MHz
IF Bandwidth (3 dB):	25 MHz (more than 420 channels, CC/GOV) 15 MHz (420 channels or less and 600 channels (underdeviated) in PSIT band)
IF Carrier Stability (AFC):	±500 kHz

RECEIVER NOISE FIGURE (Isoduplexer increases noise figure by 0.4 dB)

At Rack Flange:	10 dB maximum (Space Diversity) 12 dB maximum (CC/GOV) 13 dB maximum (Standby)

AM THRESHOLD (KTBF)*

25 MHz IF Filter:	-88 dBm
15 MHz IF Filter:	-90 dBm (Space Diversity -92 dBm) (Standby -89 dBm)

*Isoduplexer degrades threshold by 0.4 dB

RECEIVER SENSITIVITY*

Carrier level corresponding to 52 dBa0 noise figure (CC and GOV) and to an SNR of 32.5 dBp (PSIT), in highest frequency measuring channel.

With emphasis (refer to Section IV):

960 Channels (25 MHz IF):	-74 dBm (CC/GOV)
600 Channels (25 MHz IF):	-78 dBm (CC/GOV)
600 Channels (underdeviated):	-74 dBm (PSIT)
420 Channels (15 MHz IF):	-81 dBm (CC/GOV/PSIT) (Standby -80 dBm) (Space Diversity -82 dBm)

Without emphasis:

300 Channels (15 MHz IF):	-81 dBm (CC/GOV/PSIT) (Space Diversity -83 dBm)

*Isoduplexer degrades sensitivity by 0.4 dB

RECEIVER AGC

AGC Range:	50 dB
AGC Time Constant:	Up to fade rates of 100 dB/sec at fade depths of 50 dB

POWER CONSUMPTION

At 51.6 Vdc:	20 watts

DC VOLTAGE AND CURRENT REQUIREMENTS

Local Oscillator:	-24 Vdc at 125 mA
IF Preamplifier:	-24 Vdc at 65 mA
IF Amplifier and Base-band Amplifier:	-24 Vdc at 340 mA

AFC Amplifier:	-24 Vdc at 25 mA +24 Vdc at 25 mA
Noise Detector:	-24 Vdc at 45 mA
Noise Comparator:	-24 Vdc at 25 mA +24 Vdc at 25 mA
Sensing Unit:	-24 Vdc at 70 mA +24 Vdc at 2 mA

RECEIVER SQUELCH

Squelch level set to initiate at 52 dBa0 noise figure (CC and GOV) and at a SNR of 32.5 dBp (PSIT) in worst slot.

Squelch-Unsquelch Differential:	5 dB (Typical) 3 dB (Standby/Space Diversity)
Noise Detector Monitor Slot:	
25 MHz IF Filter:	9.5 MHz to 12.5 MHz
15 MHz IF Filter:	4.2 MHz to 7.5 MHz

BASEBAND SPECIFICATIONS

Output Level:	-20 dBm to -51.5 dBm (1 dB steps), (CC/GOV)* -15 dBm to -42 dBm (1 dB steps), (PSIT)*
Impedance:	75 ohms, unbalanced (nominal)**
Return Loss:	30 dB minimum, 300 Hz to 4.3 MHz (no sensing) (CC/GOV) 30 dB minimum, 300 Hz to 2.6 MHz (no sensing) (PSIT) 26 dB minimum, 300 Hz to 4.3 MHz (with sensing)

SENSING SPECIFICATIONS

Pilot Frequency:	2.1 MHz, 300-420 Channels (Standby/ Space Diversity) 3.2 MHz, 600 Channels (Standby/ Space Diversity) 3.2 MHz, 420 Channels or less 8.5 MHz, more than 420 Channels

*Refer to Section IV for emphasis specifications

**Refer to Section IV for impedance conversion options

Frequency Stability:	±0.005%
Pilot Fault Level:	6 dB drop in Pilot Level (nominal)
Pilot Filter Rejection:	47 dB (30 dB for Standby/Space Diversity)
Mixer Current Fault Level:	Drop to 25% of reference

SERVICE CHANNEL SPECIFICATIONS

Frequency Band:	300 Hz to 108 kHz
Frequency Response:	±0.2 dB, 300 Hz to 108 kHz (Single Hop)
Receiver Drop Level:	-11 dBm to -25 dBm for 75-ohm output impedance* 16 to 76 millivolts rms for 2400-ohm output impedance*

*The receiver baseband amplifier can be strapped to provide either 2400-ohm or 75-ohm output.

TELECOMMUNICATION PRODUCTS DEPARTMENT
GENERAL ELECTRIC COMPANY
LYNCHBURG, VIRGINIA

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TRS-696B (SOLID STATE)
BASIC MICROWAVE EQUIPMENT RACKS
METERING AND CONTROL

GENERAL

A basic equipment rack-up utilizes a centralized meter panel for monitoring operational performance. A selector switch mounted on the panel below the meter connects the meter to either the transmitter or receiver function selector switches. Eight transmitter and six receiver functions are monitored by respective positioning of the function and meter selector switches. The meter shelf provides two mounting shelves for control equipment associated with the fault sensing and service channel options.

METERING AND CONTROL FUNCTIONS

Transmitter and receiver metering is selected by the meter panel switch and specific functions to be measured are selected on the transmitter or receiver function switch. When the meter panel switch is placed in TRANSMITTER position, the transmitter function selector switch is rotated to any of the eight positions for monitoring purposes. When receiver functions are to be monitored, the meter panel switch is placed in RECEIVER position and the receiver function selector switch is rotated to any of its six positions. The functions which are monitored are indicated below.

TRANSMITTER	RECEIVER
RF Oscillator Current	-24 Vdc
RF Oscillator Voltage	+24 Vdc
RF Amplifier Current	Mixer Current
RF Amplifier Voltage	AGC Voltage
AFC Error Voltage	AFC Error Voltage
Varactor Voltage	Pilot Level
Power Output	
Pilot Level	

Pilot level readings are made when fault sensing is part of the equipment rack-up. A pilot oscillator installed in the meter shelf provides the continuity pilot signal which is superimposed on the transmitter baseband input. The transmit pilot level is monitored by the transmitter fault sensing unit at the output of the Crystal AFC Receiver. The receive pilot level is monitored by the receiver fault sensing unit at an isolated output of the receiver baseband amplifier. Transmit and receive pilot reject (blocking) filters are also installed in the meter shelf. These units function to prevent the continuity pilot signal from entering the associated multiplex equipment.

The service channel receive amplifier (optional) located in the meter shelf, provides the means for bridging the service channel signal from the receiver baseband output. The upper part of the meter shelf contains a test panel composed of baseband connectors and a transmit baseband pad. The baseband connectors provide monitoring points for the transmit and receive baseband signals. The transmit baseband pad provides the correct level between the multiplex baseband output and the transmitter baseband input.

SPECIFICATIONS

PILOT OSCILLATOR:

Pilot Frequency:	2.1 MHz (300-420 channels) 3.2 MHz (421-600 channels)
Frequency Stability:	±0.005%
Fault Level:	6 dB drop in pilot level (nominal)
Pilot Filter Rejection:	47 dB

SERVICE CHANNEL RECEIVE AMPLIFIER (Refer to Section IV)

TRANSMIT BASEBAND PAD (Refer to Section IV)

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GENERAL ELECTRIC COMPANY
LYNCHBURG, VIRGINIA

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RADIO RELAY EQUIPMENT

BASEBAND INTERCONNECTIONS

GENERAL

Baseband interconnect equipment is used to provide the interface requirements for rf bays and multiplex equipment. This equipment can be mounted in rf, multiplex or auxiliary bays. The type of station assembly configuration (terminal or repeater) and system considerations (channel capacity and frequency response) determines to a large extent what specific baseband interconnect equipment is required.

The minimum and maximum baseband levels in a baseband subsystem must be determined and the required interconnect equipment installed to meet requirements. A wide selection of baseband level matching pads and amplifiers can be used to meet a variety of system conditions. In some cases baseband interconnect equipment also has characteristics that influence the frequency response and channel capacity of the overall system. Baseband filters and bridges, emphasis networks, isolation transformers, amplitude equalizers and interconnection cables fall into this category.

In the equipment bays, provision is made for mounting baseband interconnect equipment or a baseband interconnect shelf which is located near the top. This shelf is divided into an upper and lower section and serves for mounting the interconnect units. In addition, the shelf provides for termination of input and output baseband, alarm and service channel connections. When it is necessary to install baseband filters (low pass, splitting filters or multiplex equipment filters) on the interconnect shelf, a filter shelf adapter is used.

In addition to the interconnect units mounted in the interconnect shelf, some types of baseband interconnect units are installed in the meter shelf (basic configuration) or in the controller shelf (standby or diversity configurations). These are the service channel or low density multiplex receive amplifier and the transmit baseband pad.

INTERCONNECT EQUIPMENT FUNCTIONS/SPECIFICATION

BASEBAND PAD

Function:	Baseband attenuation
General Use:	Adjust input and output levels of radio equipment. Used with signals from multiplex radio equipment, baseband amplifiers, or other signal sources.

Impedance:	Input and Output; 75 ohms, unbalanced. BNC connectors.
Level:	Up to 0 dBm.
Attenuation:	0 to 31.5 dB in 1/2 dB steps.

SERVICE CHANNEL PAD

Function:	Combine signals
General Use:	Combine receiver signals for operation with common Service Channel or Low Density Multiplex.
Inputs:	Frequency range; 300 Hz to 552 kHz Level; up to 0 dBm Impedance; 75 ohms, unbalanced, BNC connector.
Output:	Frequency range; 300 Hz to 552 kHz Impedance; 75 ohms, unbalanced, BNC connector.
Insertion Loss:	Input to Output; 17 dB ±0.25 dB.
Isolation:	Between input ports; 34 dB ±0.5 dB

6 DB SPLITTER

Function:	Increase number of inputs or outputs
General Use:	Service Channel application when more than one transmitter must be driven by the Service Channel.
Impedance:	Input and Outputs; 75 ohms, unbalanced, BNC connectors.
Level:	Up to 0 dBm
Insertion Loss:	Input to either output; 6 dB ±0.1 dB
Isolation:	Between independent legs; 12 dB

EMPHASIS NETWORKS

Function:	Provide constant modulation index.
General Use:	Pre-emphasis and de-emphasis networks maintain a relatively constant signal-to-noise ratio across the transmitted baseband. Pre-emphasis networks are used at multiplex output and de-emphasis networks are used at multiplex inputs.

Impedance:	Input and Output; 75 ohms, unbalanced.
Insertion Loss:	5 dB for Pre-emphasis – used in mux output 4 dB for De-emphasis – used in mux input

ISOLATION TRANSFORMERS

Function:	Transition from balanced to unbalanced line, or vice versa.
General Use:	75 ohm unbalanced line to 75 ohm balanced line where reduction of noise pick-up is required.
Impedance:	Input; 75 ohms, unbalanced, BNC connector Output; 75 ohms, balanced with dual contact connector.
Insertion Loss:	Less than 0.5 dB.

Frequency Response.

600 Channels or less:	Reference to 300 kHz; 300 Hz, 0.4 dB ±0.1 dB 2.8 MHz, 0.2 dB ±0.1 dB
More than 600 Channels: (no frequency below 12 kHz)	Reference to 300 kHz; 12 kHz, 0.1 db ±0.1 dB 5.6 MHz, 0.25 dB ±0.1 dB

IMPEDANCE CHANGE PADS

Function:	Interface with balanced impedances
General Use:	With isolation transformers
Input Impedance:	Balanced 75 ohms, 2 contact connector
Output Impedance:	Balanced 124, 130 or 135 ohms
Insertion Loss:	For 124 ohms, 6.5 dB For 130 ohms, 6.7 dB For 135 ohms, 7.0 dB, maximum

LOW-PASS AND SPLITTING FILTERS

Function:	Blocking and Baseband Splitting
General Use:	Permit re-use of one portion of the baseband spectrum and provide attenuation.
Impedance:	Input; 75 ohms, unbalanced, BNC connector Output; 75 ohms, unbalanced, BNC connector

Environmental:	+10°C to +140°C
Ripple:	Less than 0.2 dB over passband
Stopband:	Out to 5.6 MHz

Insertion Loss:

10 kHz (Low-Pass);	1.5 dB, maximum
108 kHz (Low-Pass);	2.0 dB, maximum
10-12 kHz (Splitting);	high-pass, 2.5 dB low-pass, 2.0 dB
108-112 kHz, 300-208 kHz and 552-564 kHz(Splitting);	high and low pass, 2.5 dB
804-812 kHz (Splitting);	high-pass, 6.0 dB low-pass, 6.5 dB

Attenuation:

10 kHz (Low-Pass);	70 dB above 12 kHz
108 kHz (Low-Pass);	40 dB above 112 kHz
10-12 kHz (Splitting);	50 dB below 10 kHz 70 dB above 12 kHz
108-112 kHz (Splitting);	40 dB below 108 kHz 40 dB above 112 kHz (37 dB between 1.1 and 1.3 MHz)
300-308 kHz (Splitting);	40 dB above and below
552-564 kHz (Splitting);	40 dB above and below
804-812 kHz (Splitting);	40 dB above and below

Return Loss:

108 kHz (Low-Pass);	60-108 kHz, >20 dB Below 60 kHz, >26 dB
108-112 kHz (Splitting);	60-107.7 kHz, >20 dB 112 kHz - 1 MHz, >20 dB 26 dB at other bandpass frequencies

300-308 kHz (Splitting);	Below 50 kHz, >26 dB 60-285 kHz, >21 dB 285-300 kHz, >17 dB 308-315 kHz, >17 dB 315-500 kHz, >21 dB Above 500 kHz,>26 dB
552-564 kHz (Splitting);	Below 60 kHz, >26 dB 60-490 kHz, >21 dB 495-552 kHz, >17 dB 564-580 kHz, >17 dB 580-800 kHz, >21 dB Above 800 kHz, >26 dB
804-812 kHz (Splitting);	Below 100 kHz, >26 dB 100-770 kHz, >20 dB 770-780 kHz, >15 dB 780-804 kHz, >10 dB 812-815 kHz, >11 dB 815-830 kHz, >15 dB 830 kHz - 1.5 MHz,>20 dB Above 1.5 MHz, >26 dB

BASEBAND BRIDGES

Function: Interconnect two or more radio terminals

General Use: Interconnect (4-wire basis) multiplex, radio and service channel baseband.

Input Level: -15 dBm, maximum

Impedance Terminations to bridge: 75 ohms ±1%

Isolation:

3 and 4-way ≤600 Channels;	>60 dB at 2.6 MHz (companion-ports)
3, 4 and 5-Way, >600 Channels;	>60 dB at 5.6 MHz (All ports)
6-Way, >600 Channels;	>51 dB at 5.6 MHz (All ports)

Insertion Loss at 300 kHz (all paths):

3 and 4-Way, >600 Channels;	15.6 dB ±0.15 dB
3-Way, ≤600 Channels;	6.1 dB ±0.1 dB
4 and 5-Way, >600 Channels;	12.2 dB ±0.1 dB

6-Way, >600 Channels;	18.4 dB ±0.1 dB, 18.1 dB ±0.1 dB (one port)

Return Loss (all ports):

3 and 4-Way, ≤600 Channels;	>26 dB at 2.6 MHz
3 and 4-Way, >600 Channels;	>26 dB at 5.6 MHz
5-Way, >600 Channels;	>21 dB at 5.6 MHz
6-Way, >600 Channels;	>24 dB at 5.6 MHz

Frequency Response referenced to 300 kHz:

3-Way, ≤600 Channels;	200 Hz, 0.5 dB ±0.2 dB
4-Way, ≤600 Channels;	2.6 MHz, 0.3 dB ±0.1 dB
3-Way, >600 Channels;	12 kHz, 0.1 dB ±0.1 dB 4.2 MHz, 0.1 dB ±0.1 dB 5.6 MHz, 0.2 dB ±0.2 dB
4-Way, >600 Channels;	12 kHz, 0.3 dB ±0.1 dB 4.2 MHz, 0.3 dB ±0.1 dB 5.6 MHz, 0.35 dB ±0.1 dB
5-Way, >600 Channels;	12 kHz, 0.2 dB ±0.1 dB 4.2 MHz, 0.3 dB ±0.1 dB 5.6 MHz, 0.4 dB ±0.1 dB
6-Way, >600 Channels;	12 kHz, 0.5 dB ±0.2 dB 4.2 MHz, 0.4 dB ±0.1 dB 5.6 MHz, 0.5 dB ±0.1 dB 5.6 MHz, 0.1 dB ±0.1 dB (one port)

AMPLITUDE EQUALIZERS

Function:	Improve baseband response
General Use:	Compensate for accumulated system high frequency roll-off due to baseband bridges and interconnect cables.
Impedance:	Input; 75 ohms, unbalanced, BNC connector Output; 75 ohms, unbalanced,BNC connector

Equalization:

1.3 dB Unit;	0.185 dB, 1300 kHz (300th Channel) 0.33 dB, 1860 kHz (420th Channel) 0.66 dB, 2660 kHz (600th Channel) 1.16 dB, 4188 kHz (960th Channel)
0.66 dB Unit;	0.09 dB, 1300 kHz (300th Channel) 0.166 dB, 1860 kHz (420th Channel) 0.33 dB, 2660 kHz (600th Channel) 0.62 dB, 4188 kHz (960th Channel)
Tolerance;	±0.5 dB (over +10^{o} to +50^{o}C)

AUXILIARY BASEBAND AMPLIFIER

Function:	Increase baseband signal level
General Use:	Compensate for losses in interconnect circuits at repeater stations.
Impedance:	Input; 75 ohms, unbalanced, BNC connector Output; 75 ohms, unbalanced BNC connector
Return Loss:	Input and Output; 26 dB
Gain:	15.5 dB
Output Level (Maximum):	-20 dBm/Channel for 1200 Channel System

Frequency Response:

300 Hz to 5.6 MHz;	±0.1 dB
300 Hz to 8.5 MHz;	±0.3 dB

Signal-to-Noise Ratio:

960 Channel load and -20 dBm/Channel Output:	Thermal, S/N 86 dB;/Channel. Thermal plus Intermodulation, S/N 78 dBp/Channel
Input Power:	-24 volts, 140 mA

SERVICE CHANNEL/LOW DENSITY MULTIPLEX AMPLIFIER

Function:	Increase signal level
General Use:	Increase baseband level to that required by the transmitter(s)
Impedance:	Input; 75 ohms, unbalanced, BNC connector Output; less than 300 ohms, unbalanced BNC connector.

Input Level:

High Gain Unit;	-21 to -46 dBm/Channel
Low Gain Unit;	-10 to -35 dBm/Channel

Rms Load Factor:	4.5 dB, maximum
Peak Load Factor:	13. dB, maximum
Frequency Response:	300 Hz to 108 kHz ±0.1 dB
Output Level:	715 millivolts across 2000 ohm load (12 feet of 75 ohm cable).
Input Power:	-24 volts, 45 mA

BASEBAND INTERCONNECT CABLES

Function:	Interconnection of units, shelves and equipment racks.
General Use:	Balanced cables for runs between racks. Unbalanced cables between units and shelves.
Impedance:	Unbalanced, 75 ohms Balanced, 78 ohms

CABLE CONNECTOR ADAPTERS/TERMINATIONS

BNC Adapter (female-to-female).

General Use:	Interconnect cables with BNC connectors.
Type:	UG-914U

BNC Tee Connector

General Use:	Interconnect baseband circuits
Type:	UG-274 A/U

Connector Termination (75 ohm)

General Use:	Terminate unused ports of baseband bridges or splitting filters.

BASEBAND TONE BRIDGING KIT

Function:	Interface tone and baseband circuits without multiplex equipment.

General Use:	When service channel does not have the capacity for tone transmission requirements such as telemetry and control of automated systems, alarm systems and data transmission.
Frequency Bands:	400 Hz to 16 kHz; 400 Hz to 56 kHz
Frequency Response:	400 Hz to 16 kHz system (1 kHz reference). 400 Hz to 1 kHz; -1 dB 1 kHz to 16 kHz; +1 dB 400 Hz to 56 kHz system (1 kHz reference). 400 Hz to 1 kHz; -1 dB 1 kHz to 52 kHz; +1 dB 52 kHz to 56 kHz; -2 dB
Impedance:	Input; 600 ohms, unbalanced Output; 600 ohms, unbalanced
Input Level:	Composite tone not to exceed test tone input level/channel by more than 56.5 dB.
Output Level:	Composite tone 7 dB (maximum) above test tone output level/channel of radio baseband.
Intrinsic Noise;	-60 dBm, 400 Hz -1.5 kHz and 2 kHz -56 kHz. -45 dBm, 1.5 kHz -2 kHz.
Low Pass Filters:	Insertion Loss; 0.3 dB at 5 MHz Impedance (bridging side); 5100 ohms resistive Attenuation; 50 dB above 20 kHz (16 kHz system) 50 dB above 60 kHz (56 kHz system)
600 ohm pad:	Attenuation; 0 to 31.5 dB (1/2 dB steps)
Pre-Amplifier:	Gain; 25 dB Frequency Response; +0.1 dB, 400 Hz to 56 kHz Input Impedance; 600 ohms, unbalanced Input Level; 25 dB below test tone at radio receiver output. Output Level (into 75 ohm); tone level equal to test tone level at receiver output.

Gain Amplifier:	Frequency Response; +0.1 dB, 400 Hz to 56 kHz Input Impedance; 75 ohms, unbalanced Input Level; equal to test tone level at receiver output Output Level (into 600 ohms); composite tone 7 dB (maximum) above test tone level at receiver output.

AUXILIARY MOUNTING KIT

Function:	For mounting standard EIA panels and shelves in racks.
Types:	3, 4 or 5 rack units high; 11, 13 or 15 inches maximum depth.

INTERCONNECT SHELF ADAPTERS

Function:	Provide additional mounting space for interconnect units.
Types:	8 single width unit adapter. 12 single width unit adapter.

FILTER SHELF ADAPTER

Function:	For mounting multiplex units (low pass filters and splitting (filters) in radio equipment racks.
Use:	Only when equipment rack does not include a baseband bridge unit.

TELECOMMUNICATION PRODUCTS DEPARTMENT
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TRS-696B
RADIO RELAY EQUIPMENT
POWER SUPPLY
OPERATION AND SPECIFICATIONS

GENERAL

The TRS-696B equipment bays use a single power supply for each transmitter-receiver combination and associated control equipment. The power supply receives its input from a station battery with positive ground. A battery charger maintains the station battery at a nominal 48 volt potential. The power supply is composed of solid-state components to provide operational stability over the specified temperature range.

When operation from ac source is required, an ac/dc converter unit is used to supply the input dc voltage for the TRS-696B equipment rack power supplies. The converter unit is mounted external to the TRS-696B racks.

OPERATION

The input from the nominal 48 volt station battery is applied through a circuit breaker to the input filter of the bay power supply and to an output terminal. The 48 volt output terminal is connected through the bay power cable to the bay interconnect shelf for service channel and alarm equipment. The filtered input voltage is applied to a regulator and to protective circuits. The regulator output is a highly stable -24 volt which is applied, through over-voltage and over-current detector circuits, to the bay output terminal. The regulator output also provides the regulated drive for a dc-to-dc converter. The dc-to-dc converter consists of a switching transistor circuit that chops the 24 volt input into symmetrical square wave form. The square wave is transformed and rectified to produce the dc outputs required by the bay equipment in addition to the -24 Vdc regulator output. The input circuit breaker controls all voltages that are applied to the TRS-696B bay equipment.

SPECIFICATIONS

INPUT SOURCE (POSITIVE GROUND)

Voltage:	-51.6 Vdc, +10%, -18.5%
Ripple*:	300 millivolts, peak-to-peak maximum
Spikes*:	150 millivolts peak, 100 micro-seconds maximum recovery time

Total Noise*:	0 to 3 kHz, 300 millivolts, peak-to-peak, maximum 3 kHz to 4MHz, 10 millivolts, peak-to-peak, maximum

*Reference to maximum tolerable contribution from battery chargers and other electronic equipment influences.

Power Input:	PSIT	Common Carrier
Basic Systems:	80 watts*	85 watts*
Other Systems:	175 watts*	185 watts*

*For Service Channel (one direct channel) add 5 watts. For one direct channel and four derived channels add 54 watts.

Output Voltages:

+26 ±.30 Vdc (RF Amplifier)

-32 ±.8 Vdc (Transmitter Oscillator)

-48 +9, -8 Vdc (alarm panel; service channel)

-24 +.8, -.5 Vdc (transmitter and receiver units)

+24 +.8, -.5 Vdc (control units)

+4.4 ±0.3 Vdc (control units)

Environmental Conditions:

Temperature (Operating):	-22°C to +55°C
Humidity:	Up to 95% RH
Altitude:	Up to 15,000 feet AMSL

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INSTALLATION AND CHECK OUT PROCEDURES FOR A TRS-696B BASIC/BASIC EXPANDABLE RACK

GENERAL

The procedures that follow cover the mechanical and electrical installation and preliminary rack performance check out of a TRS-696B Basic, or Basic Expandable Rack. The only auxiliary test equipment required is a multimeter with 20,000 ohms-per-volt sensitivity.

INSTALLATION

The TRS-696B radio rack must be bolted to the floor. The following procedure is recommended.

1. Set four 3/8 x 1-inch studs into the floor on the centers shown on Drawing 19C315137.

2. Remove the wooden pallet from the bottom of the rack.

CAUTION

The rack must be adequately supported at all times after the removal of the pallet.

3. Remove the grille that is across the bottom of the rack.

4. Lower the rack over the studs.

5. Swing the bottom door to its open position.

6. Secure the rack to the floor with nuts and lockwashers. The rear studs can be reached through slots in the bottom shelf; the front studs can be reached through the space between the bottom shelf and the foot plate.

7. Replace the grille plate and swing the bottom door to its closed position.

Connect the rack to the primary power source as follows:

1. Turn the power supply unit off.

2. Swing the bottom door to its open position to gain access to TB104 which is located on the rear wall of the rack.

3. Use No. 14 AWG stranded insulated wire to connect the negative side of the -42 to -57 Vdc primary power source to TB104-1, and the positive side to TB104-2.

4. Swing the bottom door to its closed position.

Connect the flange on the end of the antenna waveguide run to the flange at the top of the rack. The two flanges are fastened together with six screws. After the waveguide has been carefully aligned, the screws should be inserted and tightened evenly all the way around.

Baseband cables are brought into the rack from the top and are connected to pads and/or emphasis circuits as required on the interconnect shelf. Auxiliary circuit cables are brought into the rack from the top and connections are made to TB101 and TB102 on the alarm panel on the interconnect shelf.

RACK CHECK OUT PROCEDURE

The preliminary rack performance check out procedure is as follows:

1. Check rack meter mechanical zero; reset if necessary. To reset, open the meter door and use the mechanical zero adjustment accessible from the rear of the meter.

CAUTION

The meter mechanical zero adjustment must be made only when the power supply is turned OFF.

2. Turn the power supply unit ON. Allow the equipment to warm up for at least 15 minutes.

3. Set the METER SELECTOR switch on the meter door to its REC position.

4. Use the METER SELECTOR switch on the receiver to make the following checks:

   A. Set the selector switch to its -24V position; the meter should read red line ±3 small divisions.

   B. Set the selector switch to its +24 V position; the meter should read red line ±3 small divisions.

C. Set the selector switch to its AFC position. Set the selector switch on the AFC Amplifier to its RANGE position; the meter should read red line ±1 large division. Set the selector switch on the AFC amplifier to its ON position; the meter should read red line ±2 small divisions.

D. Set the selector switch to its AGC position: the meter should read between 0.2 and 0.55 depending on fade margin.

E. Set the selector switch to its MIX CUR position; the meter should read red line ±1 large division.

F. Set the selector switch to its PILOT position; the meter should read red line ±1 large division.

NOTE

Should any of the meter readings listed above fall outside the tolerance given, refer to Chapter 5 Section II for maintenance procedures.

5. Open the receiver door. Connect the multimeter, set to a range suitable to read 20 volts, from LO VOLT TP1 (-) to ground (+) on the LO modulation box on the shelf. The meter should read -20 ±0.1 Vdc.

6. Set the METER SELECTOR switch on the meter door to its XMIT position.

7. Use the METER SELECTOR switch on the transmitter to make the following checks:

A. Set the selector switch to its OSC CUR position; the meter should read from 0.4 to 1.0 red line.

B. Set the selector switch to its OSC V position; the meter should read 0.8 red line ±2 major divisions.

C. Set the selector switch to its AMPL CUR position; the meter should read 0.8 red line ±2 major divisions (UT-10-C only).

D. Set the selector switch to its AMPL V position; the meter should read red line ±3 small divisions (UT-10-C only).

E. Set the selector switch to its AFC position; the meter should read zero (center scale) ±2 small divisions.

F. Set the selector switch to its VAR V position; the meter should read 0.6 red line ±1 major division.

G. Set the selector switch to its POWER position; the meter should read red line ±3 small division.

H. On systems using continuity pilot signal, set the selector switch to its PILOT position; the meter should read red line ±0.5 major divisions.

NOTE

Should any of the meter readings listed above fall outside the tolerance given, refer to Chapter 5 Section I for maintenance procedures.

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GENERAL ELECTRIC COMPANY
LYNCHBURG, VIRGINIA

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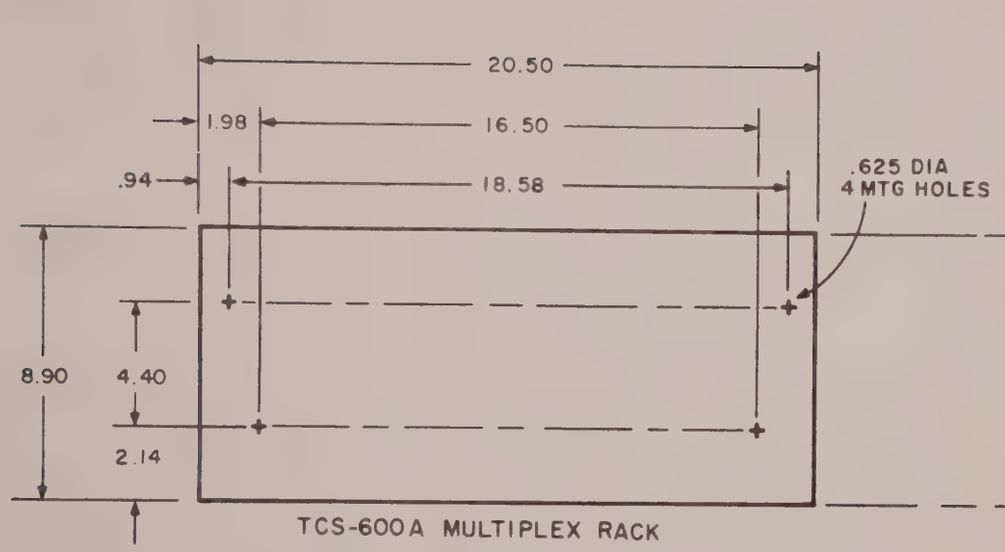
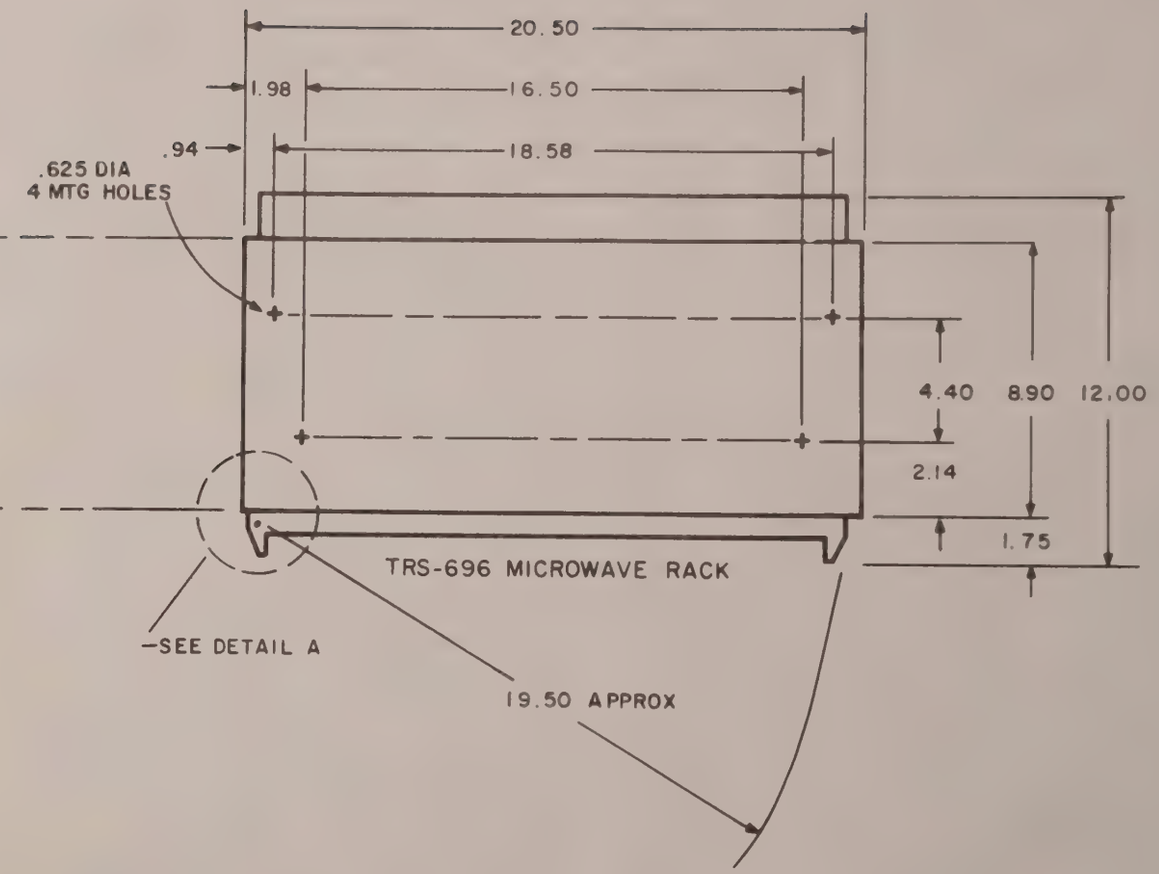
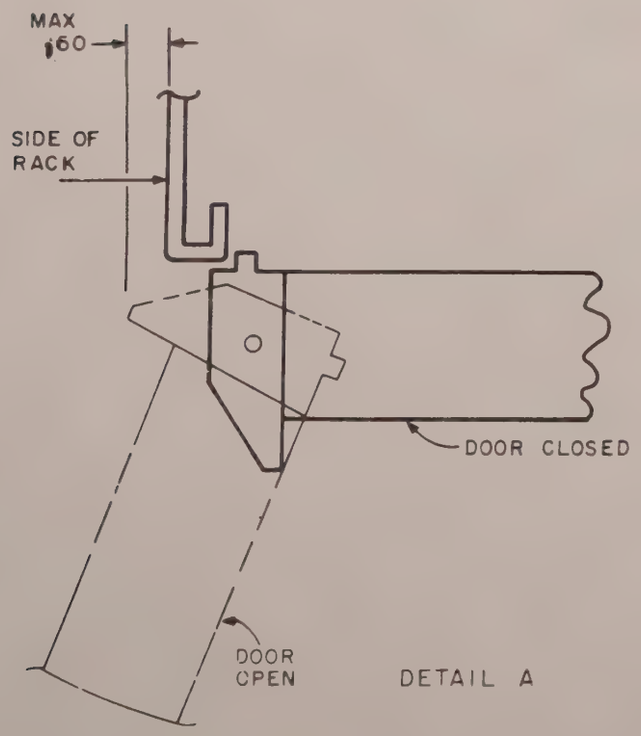






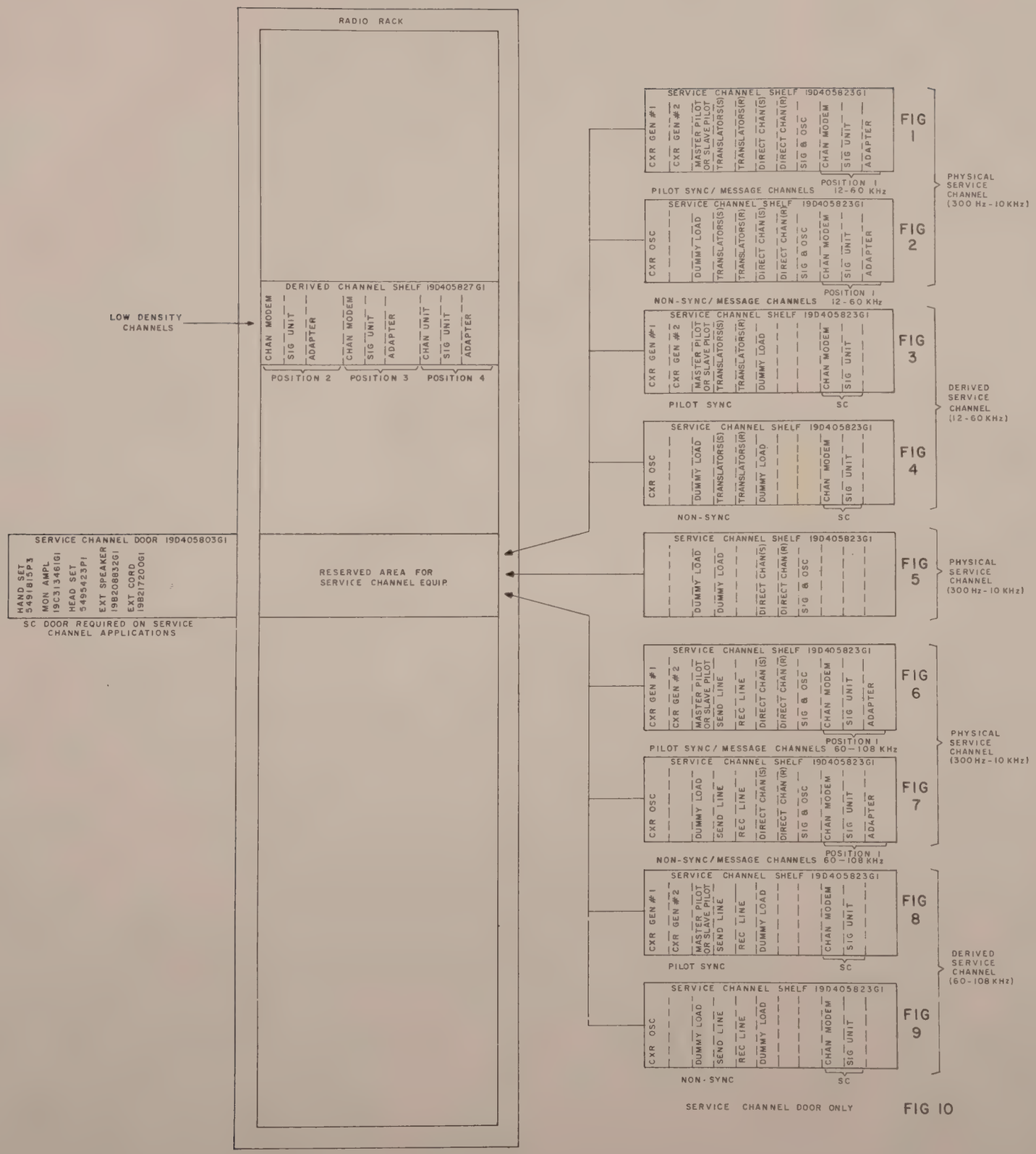
NOTES:

1. DIMENSIONAL TOLERANCE ± .02
2. MOUNTING STUDS SHOULD NOT EXTEND ABOVE THE FLOOR MORE THAN 2 INCHES.
3. FOR BAY/RACK SUPPORT LAYOUT (TOP) SEE DWG 19C316195.

Installation Diagram

BASE DRILLING & DIMENSIONS
TCS-600A MULTIPLEX BAY
TRS-696 MICROWAVE BAY

(Drawing No. 19C315137, Rev. 2)



UNIT IDENTIFICATION

CHANNEL MODEM	19D405256
SIG UNIT	19C313229G1
ADAPTER	19C306526 OR 19C306627 OR 19C306782
CXR GEN # 1	19C313407G1
CXR GEN # 2	19C313407G2
CXR OSC	19C313406
MASTER PILOT	19C313324G1
SLAVE PILOT	19C313404
SEND LINE	19C313393G1
REC LINE	19C313391G1
TRANSLATOR (S)	19C313392G1
TRANSLATOR (R)	19C313390G1
DIRECT CHAN (S)	19C313410G1
DIRECT CHAN (R)	19C313411G1
SIG & OSC	19C313229G2
DUMMY LOAD	19C313373G1

NOTE 1. ON CARD GUIDE ON BOTTOM SHELF OF SERVICE CHANNEL, MARK THE SIX DIGET NUMBER PLUS GROUP NUMBER OF EACH CARD IN THE SHELF. THE MARKING SHOULD BE IN FRONT OF THE SLOT IN WHICH THE CARD IS INSERTED. MARK AT RACK ASM PER 19A115740P1, COLOR BLACK CHARACTERS .125 HIGH.

2. CHANNELS ARE ASSIGNED PROGRESSIVELY FROM POSITION 1 TO 4, WITH POSITION 1 CONTAINING THE LOWEST CHANNEL NO.

SERVICE CHANNEL IDENTIFICATION

(Drawing No. 19D418025, Sh. 1, Rev. 1)

PERFORMANCE CHECKOUT PROCEDURE FOR A TRS-696B BASIC/BASIC EXPANDABLE TO STANDBY RACK PSIT BAND

GENERAL

The outlined procedures check the performance of a TRS-696B Basic or Basic Expandable to Standby Rack. All procedures except the signal-to-noise test can be performed on a single rack by one man. The signal-to-noise test requires two men, one at each station at each end of the path. For this test a means of communications between the two stations is required (such as the optional Service Channel Unit).

The following auxiliary test equipment is required:

1. Multimeter: 20,000 ohms-per-volt sensitivity
2. AC VTVM: Hewlett-Packard HP400EL or equivalent (2 each)
3. *Selective Voltmeter: Hewlett-Packard HP312A or equivalent
4. General Electric Test Set: Model 4UZ24A1
5. Signal Generator: Hewlett-Packard HP651B or equivalent
6. Frequency Counter: Hewlett-Packard HP5246L with HP5255A head or equivalent
7. Power Bridge: Hewlett-Packard HP431A or equivalent
8. Thermistor Mount: Hewlett-Packard HP478A or equivalent
9. White Noise Set: Siemens-Halske REL 33K 122, or Marconi Model 2090 (with necessary filters and oscillator modules).
10. Variable Baseband Attenuator: Telonic Model TG-9075 or equivalent

*Optional equipment for continuity pilot sensing check. Can be deleted under certain conditions. Refer to (TRANSMITTER FAULT SENSING CHECK AND RECEIVER FAULT SENSING CHECK).

Accessories:

Cable, RG59-BU, 3 feet (3 each) 75-Ω

Cable, RG59-BU, 6 feet (2 each) 75-Ω

Cable, RG58-AU, 3 feet (1 each) 50-Ω

Cable, RG58-AU, 6 feet (1 each) 50-Ω

Connector: BNC "Tee" (5 each)

Termination: BNC 75 Ω

Connector: BNC to BNC make (2 each)

Connector: Type "N" to BNC

Plug: GR to BNC (2 each)

Adapter: Waveguide to coax Hewlett-Packard Model J281A

Waveguide Extension: GE No. 19B208881-G1. Required for basic rack power output check if base band bridge is housed in rack. (Refer to TRANSMITTER POWER MEASUREMENT)

Allow the equipment to warm up for at least one hour before starting the checkout procedures.

PERFORMANCE AND CHECKOUT PROCEDURES

NOTE

At the completion of each check, all FAULT indicators and SQUELCH indicators should be out. If either (or both) is on, some part of the check has been performed incorrectly.

TRANSMITTER FREQUENCY MEASUREMENT: Check transmitter frequency as follows:

NOTE

This procedure cannot be performed without interrupting traffic.

1. Open the transmitter door. Ascertain that the AFC ON-SET switch on the inside of the door is in its ON position. Place the OPERATE/TEST switch on the transmitter rf oscillator chassis to its TEST position.

2. Connect the frequency counter to jack J6; measure and record frequency. Frequency should be within ±0.002% of the assigned channel frequency.

NOTE

If frequency is outside these limits, refer to Chapter 5, Section I for adjustment procedures.

3. Disconnect the counter, place the OPERATE/TEST switch in its OPERATE position, and close the transmitter door.

TRANSMITTER POWER MEASUREMENT

1. Remove the cover from the cross guide coupler located at the top of the rack near the interconnect shelf.

NOTE

On some basic rack configurations, the interconnect shelf door must be opened to gain accessability to the coupler. If a bridge is housed in this shelf, a waveguide extension (GE 19B208881-G1) must be connected to permit connection of the waveguide adapter and thermistor mount (step 2).

2. Connect the waveguide adapter, thermistor mount, and power bridge.

CAUTION

Before making this connection, be certain of the coupling factor (marked on the crossguide coupler) and the proper scale setting to use on the power bridge. The thermistor mount can be damaged if input power exceeds 10 mW.

3. Measure and record transmitter power output. This should be at least +30.0 dBm unless an isoduplexer is used in the waveguide stack, in which case it should be at least +29.6 dBm for the UT-10-C system. For the UT-10-D system the power output should be +24 dBm and +23.6 dBm respectively.

NOTE

Transmitter power output will be the algebraic sum of the meter reading and coupling factor or: meter reading +coupling factor = power output. Example: coupling factor is 30 dB, meter reading is -1.5 dBm, the power output is: -1.5 + 30 = +28.5 dBm.

4. Disconnect the thermistor mount, waveguide adapter (and, if used, the waveguide extension) from the coupler. Reconnect the coupler cover.

RECEIVER BASEBAND GAIN

NOTE

If the radio rack has been furnished with sensing equipment (optional equipment) a good indication of correct receiver baseband gain can be obtained by monitoring the receiver continuity pilot level or the rack panel meter (step 1, RECEIVER FAULT SENSING CHECK). If a red line meter indication is obtained, baseband gain is properly adjusted.

If necessary, the receiver baseband gain can be checked as outlined below. It will be necessary to interrupt traffic for this test.

1. Open the receiver door and disconnect the cables from J16 and J19 (located at the right side of the door assembly).

2. Connect the General Electric Test Set (ML 4UZ24A1) to the receiver as follows:

   A. Turn the selector switch to its 65-75 MHz position.

   B. Put the DEVIATION-MARKER switch in its DEVIATION position.

   C. Put the 10 dB ATTENUATOR switch in its IN position.

   D. Connect the OUTPUT jack to J16 on the receiver with RG58-AU cable.

3. Connect a 75-ohm terminated AC VTVM to J19 on the receiver door using RG59-BU cable. Refer to Table I for the required AC VTVM indication. If necessary, turn the GAIN ADJ control (located on left side of door assembly) to obtain the correct indication.

NOTE

For most applications, this indication is 760 mV, corresponding to a test tone deviation of 200 kHz and output level of -20 dBm. Table I lists the levels associated with non-standard test tone deviations and levels.

4. Disconnect the test equipment from the receiver and reconnect the cables to J16 and J19. Close the receiver door.

NOTE

If the baseband gain is not as specified, and cannot be adjusted as outlined in step 4, refer to Chapter 5 Section II for maintenance procedure.

TRANSMITTER BASEBAND GAIN

NOTE

If the radio rack has been furnished with sensing equipment (optional equipment), a good indication of correct transmitter baseband amplifier gain can be obtained by monitoring the transmitter continuity pilot level on the rack panel meter (step 1, TRANSMITTER FAULT SENSING CHECK). If a red line meter indication is obtained, baseband gain is properly adjusted.

If necessary, the transmitter baseband amplifier gain can be checked as outlined below. It will be necessary to interrupt traffic for this test.

1. Open the transmitter door and place the OPERATE/TEST switch on the transmitter rf oscillator in its TEST position.

2. Connect a signal generator to the TEST input of the baseband amplifier using RG59-BU cable. Bridge an unterminated AC VTVM directly onto the test cable.

3. Set the generator frequency to 300 kHz and the generator output level to 12.2 mV. Disconnect the AC VTVM.

NOTE

If the radio equipment is to operate at the special test tone input level of -45 dBm (rather than the standard -42 dBm), set the generator level to 8.7 mV.

4. Open the receiver door and disconnect the cables at J16 (IF input) and J19 (baseband output) on the door. Connect a 75 ohm terminated AC VTVM to J19 using RG59-BU cable.

5. Connect J16 on the receiver door to the J3 BNC connection (70 MHz TEST) on the transmitter waveguide-mounted AFC unit using a six-foot length of RG58-AU cable.

6. Note AC VTVM indication. It should be 6 dB below (or 1/2) the level given in Table I for the modulation and continuity pilot conditions used.

Table I. Test Procedure (Receiver Baseband Gain), (Transmitter Baseband Gain), (Receiver Fault Sensing)

Channel Loading	Test Tone Rcvr Output Level	Continuity Pilot (4) Frequency	Continuity Pilot (4) Level (Rcvr Fault Sensing)	Test Tone Underdeviation (3) (Ref. 200 kHz)	(Rcvr Baseband Gain) HP-400EL (1) Indication (Using GE Test Set)	(Transmitter Baseband Gain) Meter Indication
≤ 300	-20 dBm	None	-	0 dB	760 mV	154 mV
		2.1 MHz	19.4 mV	0	760	154
	-15 dBm	None	-	0	677 (2)	274
		2.1 MHz	34.5 mV	0	677 (2)	274
420	-20 dBm	None	-	0 dB	760 mV	154 mV
		2.1 MHz	19.4 mV	-1	852	154
	-15 dBm	None	-	0	677 (2)	274
	-16 dBm	2.1 MHz	30.8 mV	-1	677 (2)	244
600	-20 dBm	None	-	-4 dB	604 (2) mV	154 mV
	-22 dBm	3.2 MHz	15.4 mV	-7	677 (2)	122

Notes:
1. If a "RMS RESPONDING" meter such as a HP-3400A is used, reduce levels 0.9 dB.
2. Set GE Test Set Output to 70-75 MHz for this level.
3. Underdeviation required to insure compliance with FCC restriction on necessary bandwidth.
4. Continuity pilot sensing is optional on Basic and Basic Expandable configurations.

NOTE

For most applications using the standard -20 dBm test tone output, the Table I level is 154 mV. The step 6 meter indication should therefore be 77 mV. Table I lists levels for other test tone conditions.

7. If necessary, adjust the GAIN ADJ control (R26) on the transmitter rf oscillator chassis to obtain the correct indication.

8. While monitoring the AC VTVM, depress the pushbutton switch S1 (red) on the transmitter 70 MHz reference oscillator unit. The meter indication should be at the Table I listed value (154 mV for the standard -20 dBm test tone output level). Release the switch.

9. If the step 8 meter indication is not at the correct level, adjust the GAIN ADJ as necessary to achieve the required level.

NOTE

1. Prolonged depression of switch S1 can result in transmitter frequency drift and a possible change in the meter indication.

2. If the steps 7 and 9 adjustments do not yield the specified results, refer to Chapter 5, Section I for the maintenance procedure.

10. Disconnect all test equipment, reconnect the cables to J19 and J16 on the receiver door. Place the transmitter OPERATE/TEST switch in its OPERATE position. Close the transmitter and receiver doors.

NOTE

If the rack is equipped for sensing, proceed to check transmitter and receiver fault sensing as outlined in paragraphs (TRANSMITTER FAULT SENSING CHECK and RECEIVER FAULT SENSING CHECK); if the rack is not equipped for sensing, omit these two procedures and go to the noise test given in paragraph (INTERMODULATION NOISE TEST).

TRANSMITTER FAULT SENSING CHECK

1. Check the fault sensing as outlined below:

A. Turn the METER SELECTOR switch on the meter door (controller door on basic expandable) to its TRANSMITTER

position (XMTR A position on the controller door).

B. Turn the METER SELECTOR switch on the transmitter to its POWER and PILOT positions in turn; in each position the rack meter should read to red line, and the red FAULT indicator on the transmitter door should be out.

C. If the checks outlined in step 1B above yield the specified results, the sensing circuits can be considered properly adjusted and steps 2 and 3 can be omitted; if, however, the checks outlined in step 1B does not yield the specified results, the sensing circuits in the transmitter involved must be adjusted as outlined in steps 2 and 3.

2. If the POWER meter indication is not at red line, perform the following steps:

A. Turn the selector switch on the transmitter door to its POWER position and adjust the POWER MONITOR control (R5) on the AFC control panel (on back of the transmitter door) to obtain a rack meter reading of 0.5.

B. Adjust POWER MONITOR GAIN control R40 on the transmitter sensing unit until the red FAULT indicator on the transmitter door turns on.

C. Adjust the POWER MONITOR control (R5) on the AFC control panel to obtain a red line reading on the rack meter. The red FAULT indicator should go out.

3. If the PILOT indication is not at meter red line, perform the following steps:

NOTE

If a selective voltmeter, tunable to the continuity pilot frequency, is available, this procedure (step A) can be performed without interrupting traffic. If a selective voltmeter is not available, proceed to step B.

A. Pilot sensing check using a selective voltmeter:

1. Open the transmitter door. Connect an unterminated selective voltmeter to the TEST INPUT, BNC connector J3 on the transmitter rf oscillator chassis. Use no more than 3 feet of RG59-BU cable. The OPERATE/TEST switch should be in its OPERATE position.

2. Tune the selective voltmeter to the continuity pilot frequency. Pilot level should be 1.54 mV.

NOTE

If the radio equipment is to operate at the special test tone input level of -45 dBm (rather than the standard -42 dBm), pilot level should be 1.09 mV.

3. If the pilot level is correct, proceed to step 6. If the pilot level is not correct, proceed to step 4.

4. Open the meter door (controller door on basic expandable). Adjust the pilot level control (R11) (rear pot) on the plug-in pilot generator unit to obtain the correct level.

NOTE

If unable to achieve the specified pilot level, check the position of the pilot fault level control R1 (front pot) on the pilot generator unit. It should be set at approximatley 3/4 of its maximum clockwise position.

5. Note the transmitter PILOT rack meter indication. If at red line, the pilot sensing check is complete and the selective voltmeter can be disconnected. If not at red line, proceed to step 6.

6. Remove the cover from the transmitter sensing unit located on the transmitter door.

7. Adjust R1 on the sensing unit (Pilot Rec. Gain Adj.) until the red FAULT indicator on the door just turns on.

8. Adjust R20 (Pilot Meter Adj.) for a PILOT rack meter indication of 0.55 of red line.

9. Adjust R1 for a red line rack meter indication.

10. Disconnect the selective voltmeter. Replace the cover on the sensing unit. Close the transmitter door. This completes the pilot check.

B. Pilot sensing check, using wideband VTVM.

NOTE

On a basic rack, a signal generator is also required. Start at step 1 for this check. On a basic expandable rack, a pilot test output is furnished; start at step 2 for this rack.

1. On a basic rack, perform the following steps:

   a. Open the transmitter door and place the OPERATE/TEST switch on the transmitter rf oscillator chassis in its TEST position.

   b. Connect the output from a signal generator to the TEST INPUT connector (J3) using RG59-BU cable. Bridge an unterminated AC VTVM directly onto this cable.

   c. Set the generator frequency to the continuity pilot frequency and the generator level to 1.54 mV (if the pilot frequency is unknown, remove the pilot generator unit from the meter shelf and note the crystal frequency).

NOTE

If the radio equipment is to operate at the special test tone input level of -45 dBm (rather than the standard -42 dBm), set the generator level to 1.09 mV.

   d. Note the transmitter PILOT rack meter indication (slowly tune the generator frequency control to peak this indication). Proceed to step 3.

2. On a basic expandable rack, perform the following steps:

   a. Open the transmitter door and place the OPERATE/TEST switch on the transmitter rf oscillator chassis to its TEST position.

   b. Open the controller door. A PILOT TEST OUTPUT jack J1 is provided on the test panel located within the shelf. Connect this jack, through an external variable attenuator, to the INPUT TEST connector (J3) on the transmitter oscillator chassis using RG59-BU cable. Bridge an unterminated AC VTVM directly to this cable after the attenuator.

   c. Using the external attenuator and, if necessary the TEST PILOT ADJ control (R5) on the test panel in the controller shelf, obtain an AC VTVM indication of 1.54 mV.

NOTE

If the radio equipment is to operate at the special test tone input level of -45 dBm (rather than the standard -42 dBm), set the level to 1.09 mV.

d. Note the transmitter PILOT rack meter indication. Proceed to step 3.

3. If a red line indication is obtained, disconnect the cable from the TEST input of the transmitter rf oscillator chassis and place the OPERATE/TEST switch in its OPERATE position, and proceed to step 10. If the rack meter indication is not red line, proceed to step 4.

4. Remove the cover from the sensing unit on the transmitter door.

5. Adjust R1 on the sensing unit (Pilot Rec. Gain Adj.) until the red FAULT indicator on the door just turns on.

6. Adjust R20 (Pilot Meter Adj.) for a PILOT rack meter indication of 0.55 of red line.

7. Adjust R1 for a red line rack meter indication.

8. Replace the sensing unit cover. Disconnect the cabling and equipment from the TEST input on the transmitter rf oscillator chassis. Place the OPERATE/TEST switch in its OPERATE position, close the transmitter door.

9. Note the transmitter PILOT rack meter indication. If a red line indication is obtained, the pilot sensing check is completed. If the indication is not red line, proceed to step 10.

10. Open the meter door (controller door on basic expandable) and adjust the pilot level control R11 (rear pot) on the pilot generator plug-in card to obtain a red line indication.

NOTE

If unable to achieve the specified pilot level, check the position of the pilot fault level control (R1) (front pot) on the pilot generator unit. This control should be set to approximately 3/4 of its maximum clockwise position.

11. Close the meter door (controller door on basic expandable). This completes the pilot sensing check.

RECEIVER FAULT SENSING CHECK

1. Check the receiver fault sensing as follows:

   A. Turn the METER SELECTOR switch on the meter door (controller door on basic expandable) to its RECEIVER position. (RCVR A position on the controller.)

   B. Turn the METER SELECTOR switch on the receiver to its MIX CUR and PILOT positions in turn: in each position the meter should read red line (within ±1 major division), and the red FAULT indicator on the receiver door should be out.

   C. If the checks outlined in step 1B above yield the specified results, the sensing circuits can be considered properly adjusted and steps 2 and 3 can be omitted; if, however, the checks outlined in step 1B does not yield the specified results, proceed to steps 2 and 3.

2. If the MIX CUR meter indication is not at red line, open the receiver door and adjust the waveguide LO attenuator for a red line indication.

NOTE

If the MIX CUR cannot be adjusted as specified, refer to Chapter 5, Section II. A low MIX CUR meter indication can also result if the strapping in the AFC amplifier (located on the receiver door) is incorrect. This strapping is dependent upon the LO frequency placement relative to the incoming carrier frequency. Refer to Elementary Diagram 19D405342.

3. If the PILOT meter indication is not at red line, perform the following steps:

NOTE

This procedure cannot be performed without interrupting traffic unless a selective voltmeter, tunable to the pilot frequency, is available. Proceed to step A if a voltmeter is available. Proceed to step B if a selective voltmeter is not available.

   A. Receiver pilot sensing check using a selective voltmeter.

      1. Open the receiver door and connect a 75-ohm terminated selective voltmeter to the baseband monitor (J20).

2. Turn the voltmeter to the continuity pilot frequency and note the meter indication. Refer to Table I for the correct pilot level. For most applications, with the receiver equipment set for a -20 dBm test tone output level, the pilot level should be 19.4 mV within ±1.2 mV. Table I lists the pilot levels corresponding to other test tone output levels.

3. If the pilot is at the correct level, proceed to step 4. If the pilot is not at the correct level, then either the receiver baseband gain is misadjusted, refer to paragraph (RECEIVER BASEBAND GAIN), or the transmitter at the adjacent station has a misadjusted baseband gain, refer to paragraph (TRANSMITTER BASEBAND GAIN), or pilot generator level, refer to paragraph (TRANSMITTER FAULT SENSING CHECK). Correct adjustments must be made before proceeding.

NOTE

Receiver pilot sensing can be checked without adjacent station transmitter adjustments by following step B below. Traffic must be interrupted for this check however.

4. Remove the sliding cover from the receiver sensing unit (back of receiver door on hinged panel).

5. Adjust the Pilot Rec. Gain Adj. control (R1) until the red FAULT indicator on the receiver just turns on.

6. Adjust the Pilot Meter Adjust control (R20) for a 0.55 of red line PILOT rack meter indication.

7. Adjust Pilot Rec. Gain Adj. (R1) for a red line PILOT meter indication.

8. Replace the sensing unit cover and close the receiver door. This completes the pilot sensing check.

B. Receiver pilot sensing check without using a selective voltmeter.

NOTE

Traffic must be interrupted for this test. It is assumed that transmitter sensing has been checked (paragraph TRANSMITTER FAULT SENSING CHECK).

1. Open the transmitter and receiver doors. Disconnect the IF input cable at J16 on the receiver door.

2. Connect J16 on the receiver to J3 (70 MHz TEST) on the waveguide-mounted AFC unit in the transmitter shelf using six feet of RG58-AU cable.

3. Remove the sliding cover from the Receiver Sensing Unit (located on back of hinged panel on door). Adjust the Pilot Rec. Gain Adj. control (R1) until the red FAULT indicator on the door just turns on.

4. Adjust the Pilot Meter Adj. control (R20) for a meter indication at 0.8 of red line.

5. While depressing the pushbutton switch S1 (red) on the transmitter 70 MHz Reference Oscillator Unit (located on bracket to right of waveguide-mounted AFC Unit), note the meter indication difference from red line. Release the switch.

6. Using the Pilot Meter Adj. control (R20), change the 0.8 meter indication of step 4 by the amount and opposite direction of the difference noted in step 5.

7. Repeat step 5. The indication should be red line. If not, repeat steps 5 and 6 until a red line indication is obtained.

NOTE

Prolonged depression of switch S1 can result in a changing meter indication. Depress only momentarily.

8. Disconnect the RG58-AU test cable. Put the cover on the sensing unit. Reconnect the J16 cable to the receiver door. Close all doors.

9. Note the receiver PILOT rack meter indication. If not at red line then the transmitter at the adjacent station has a misadjusted baseband gain or pilot level. These can be checked by following paragraphs (TRANSMITTER BASEBAND GAIN and TRANSMITTER FAULT SENSING CHECK) respectively.

INTERMODULATION NOISE TEST: This procedure involves putting a white noise signal into the transmitters at one station and checking the intermodulation noise at the output of the receiver at the adjacent station. For the purpose of clarity, white noise signal is applied to the transmitter at Station No. 1 and noise level is checked at the output of the receiver at Station No. 2.

NOTE

This procedure cannot be performed without interrupting traffic. The signal-to-noise (or noise power ratio) values given are typical values based on a 40 dB fade margin and an assumed feeder line echo distortion level. Some variations from these values will be experienced dependent upon the actual fade margin, feeder line echo distortion level, and ambient temperature. No pre-emphasis networks are used in these tests. For the TRS-696B, loadings of 420 channels or more are generally emphasized. However, compliance with the specifications set forth will ensure compliance for emphasized loadings.

1. Connect the white noise set to the transmitter at Station No. 1 as follows:

   A. Connect a 75-ohm resistor across the AC VTVM terminals and connect the meter across the white noise set output using RG59-AU cable.

   B. Adjust the white noise set to the level required for the desired channel loading which is given in Table II. Standard TRS-696B per channel input level is -42 dBm. For example: for a channel loading of 300 at a per channel input of -42 dBm, adjust the white noise test set to obtain a meter reading (HP400EL) of 5.95 mV.

   C. Disconnect the meter and connect the white noise set to INPUT MON/TEST jack J3 on the transmitter rf oscillator chassis; the OPERATE/TEST switch should be in its TEST position.

2. An AC VTVM and the white noise set (receiver) are connected in turn to the output of the receiver at Station No. 2 as outlined in step 3.

3. Connect the test equipment to the receiver as follows:

   A. Open the receiver door and disconnect the cable from jack J19.

   B. Connect a 75-ohm terminated AC VTVM to J19. Determine the meter reading from Table II using the same channel loading selected for step 1B. Standard TRS-696B per channel output level is -20 dBm. For example: for a channel loading of 300 at an output per channel level of -20 dBm, the meter (HP400EL) should read 74.9 mV.

   C. Disconnect the AC VTVM and connect the white noise set (receiver) to J19 on the receiver door.

Table II. Test Procedure (Intermodulation Noise Test)

Channel Loading	Measuring Slot Frequencies			Noise Input Level (1) Meter Indication for Test Tone Input		Noise Output Level (1) Meter Indication for Test Tone Output		
	Lo	Mid	Hi	Standard -42 dBm	(Special) -45 dBm	Standard (2) -20 dBm	(Special) -15 dBm	Max. Level When Cont. Pilot Used
60	70 kHz	-	270 kHz	3.88 mV	2.75 mV	48.8 mV	86.9 mV	(Special) 86.9 mV
120	70	-	534	4.46	3.16	56.1	100.0	(Special) 100.0
240	70	-	1002	5.34	3.78	67.1	126.0	(Special) 126.0
300	70	-	1248	5.95	4.22	74.9	133.0	(Special) 133.0
420	70	1248	1722	7.02	4.98	89.2	157.0	(Special) (-16 dBm) 140 mV
600	70	1248	2438	8.40	5.95	106.0 (3)	-	(-22 dBm)84.1 mV

Notes:
1. Use of an "Average Responding" meter is assumed (HP-400EL). With use of a "RMS Responding" meter (HP-3400A), increase levels 0.9 dB.
2. Standard levels, with or without continuity pilot, except for 600 channels. For 600 channels, refer to note 3. Continuity pilot sensing is optional on Basic and Basic Expandable Racks.
3. Standard level for 600 channels without pilot. With pilot sensing, max. and standard test tone output level is -22 dBm and noise level is 84.1 mV.

4. Determine the intermodulation noise at Station No. 2 as follows:

   A. Refer to Table II for the noise measuring channels corresponding to the channel loading selected for step 1B. For example: for 300 channels use the 70 MHz and 1248 kHz slots.

   B. Read and record the thermal and thermal plus intermodulation signal-to-noise ratio (or noise power ratio) in each. Typical values are tabulated in Table III.

Table III. Test Procedure (Intermodulation Noise Test)

1. Thermal Signal-to-Noise (40 dB Fade Margin)*

Channel Loading	Measuring Slot Frequency					
	Low		Middle		High	
	S/N	NPR	S/N	NPR	S/N	NPR
300	77 dBp	58 dB	-	-	71 dBp	52 dB
420	77	58	71 dBp	52 dB	69	50

2. Thermal Plus Intermodulation Signal-to-Noise

Channel Loading	Measuring Slot Frequency					
	Low		Middle		High	
	S/N	NPR	S/N	NPR	S/N	NPR
300	75 dBp	56 dB	-	-	70 dBp	51 dB
420	74	55	70 dBp	51 dB	67	48

*On space diversity systems, add 2 dB to all slots.

NOTE

The S/N readings in Table III above are referenced to a fade margin of 40 dB. For fade margins less than 40 dB, subtract the difference from the readings obtained in the high slot (and intermediate slot if one is used) in step B. For example: if fade margin is 35 dB, subtract 5 dB from the readings.

NOTE

If the measured S/N values are greatly degraded from the Table III values, refer to Chapter 5 for linearity adjustment procedures. Some guides to possible causes of S/N degradation are listed under Troubleshooting Guide to Determine Probable Causes of S/N Degradation.

C. Disconnect the white noise set and reconnect the cable to J19 on the receiver door.

5. Disconnect the white noise set from INPUT MON/TEST jack J3 on the transmitter rf oscillator chassis at Station No. 1 The OPERATE/TEST switch should be returned to its OPERATE position.

6. Check the noise level at the output of each receiver at Station No. 1 by reversing the roles of the two stations and repeating steps 1 through 5.

7. When the noise level at both stations has been checked, disconnect all test equipment.

SQUELCH LEVEL: Check the receiver squelch level on the receiver at both stations as follows:

NOTE

This procedure cannot be performed unless the receivers are equipped with the (optional) fade simulator. If traffic on the system is at the frequency of the high measuring slot, traffic must be interrupted to perform this check. Refer to the notes at the end of the following procedure.

1. Open the receiver door and connect the white noise set receiver to the baseband output monitor (J20).

2. Slowly turn the fade simulator until the red SQUELCH indicator turns on. The S/N in the high frequency measurement slot should be within ±1.5 dB of 29.5 dBp (NPR of 10.5 dB) for loadings of 420 channels or more, or 32.5 dBp (NPR of 13.5 dB) for loadings of 300 channels or less. Note and record the fade simulator dial setting. Using the calibration chart furnished on the receiver waveguide, determine the attenuation of the simulator setting. It should be at least 40 dB.

3. If the S/N values of step 2 are not met, set the fade simulator to the point providing the specified S/N values and adjust the SQUELCH ADJUST control on the noise detector unit

(located on the receiver door) until the red SQUELCH indicator just turns on. Record the fade simulator setting.

4. Return the fade simulator slowly to its original 0 position. The red SQUELCH indicator should turn off. Disconnect the noise set and close the receiver door.

NOTE

1. Subsequent checks can be made using the recorded fade simulator settings in conjunction with the status of the indicators. Repeatability should be within ±2 dial divisions (an additional allowance must be made for changes in transmitter output power).

2. A selective voltmeter can be used in place of the noise set if it is tunable to the high measurement frequency and if its bandwidth is at least 1 kHz. If traffic is in the high frequency slot, tune the voltmeter in the immediate vicinity for a "quiet" slot. For a 3 kHz wide voltmeter bandwidth S/N values should be 2.5 dB worse than specified. For a 1 kHz bandwidth, S/N values should be 2.3 dB better than specified. All S/N values are referenced to the test tone output level (-20 dBm standard).

3. If the 40 dB attenuation setting of step 2 is not met, refer to (Troubleshooting Guide to Determine Probable Causes of S/N Degradation).

TRS-696B BASIC/BASIC EXPANDABLE RACK

Troubleshooting Guide to Determine Probable Causes of S/N Degradation.

NOTE

Ascertain that the transmitter and receiver baseband are properly adjusted in the sequence described paragraphs (RECEIVER BASEBAND GAIN and TRANSMITTER BASEBAND GAIN) respectively. Ascertain that the S/N test equipment levels correspond to the equipment input and output test tone levels.

A. Poor High Slot Thermal S/N:

1. Check transmitter output power (TRANSMITTER POWER MEASUREMENT).

2. Check squelch level (SQUELCH LEVEL).

   a. If squelch meets the 40 dB specification proceed to step B. If squelch does not meet specification, check the path squelch in reverse direction.

   b. If the squelch in reverse direction also does not meet specification (assuming transmitter power output is within specification), problem is in path, antenna alignment, or excessive feeder line losses.

   c. If squelch in reverse direction is within specification, perform steps below on receiver with poor thermal S/N:

      1) Replace receiver door (check AFC amplifier straping and baseband gain on new door).

      2) Replace mixer diode.

      3) Check-out IF preamplifier per Chapter 5, Section II.

B. Poor Low Slot Thermal S/N:

1. Check rack and station grounds. Ground test equipment to rack.

2. Use the GE Test Set to inject a 70 MHz signal into J16 on the receiver door (test set switches in MARKER and 70 MHz positions). If thermal S/N is poor, replace door (check AFC amplifier strapping and baseband gain on new door).

3. Replace transmitter rf oscillator chassis (check baseband gain).

4. Replace local oscillator in receiver.

C. Poor High Slot Intermodulation S/N:

1. Cause could be excessive feeder line echo distortion. Check VSWR of feeder line.

2. Cause could be transmission path echo. Slight antenna realignment could help.

3. Cause could be RF interference from either local station.

4. Perform delay and linearity checks outlined in Chapter 5, Section III.

D. Poor Low Slot Intermodulation S/N:

1. If one transmitter checks poorly, perform the following procedure:

   a. Turn the transmitter AFC ON-SET switch to its SET position.

   b. After approximately two minutes, turn the METER SELECTOR switch on the transmitter to its VAR V position, and use the rack meter to check varactor voltage; if necessary, adjust the VAR VOLT control on the door to obtain the meter reading stamped on the transmitter rf oscillator chassis.

   c. Adjust rf oscillator FREQ ADJ screw for proper transmitter frequency.

   d. Turn the transmitter AFC ON-SET switch to its ON position and recheck intermodulation; if it is still excessive, refer to Chapter 5 for procedures to adjust linearity and coupling.

2. If one receiver checks poorly, adjust LIN ADJ on inside of receiver door for minimum low slot intermodulation. Recheck receiver baseband gain after this adjustment.

NOTE

If above checks do not isolate cause of problem, refer to Chapter 5.

TELECOMMUNICATION PRODUCTS DEPARTMENT
GENERAL ELECTRIC COMPANY
LYNCHBURG, VIRGINIA

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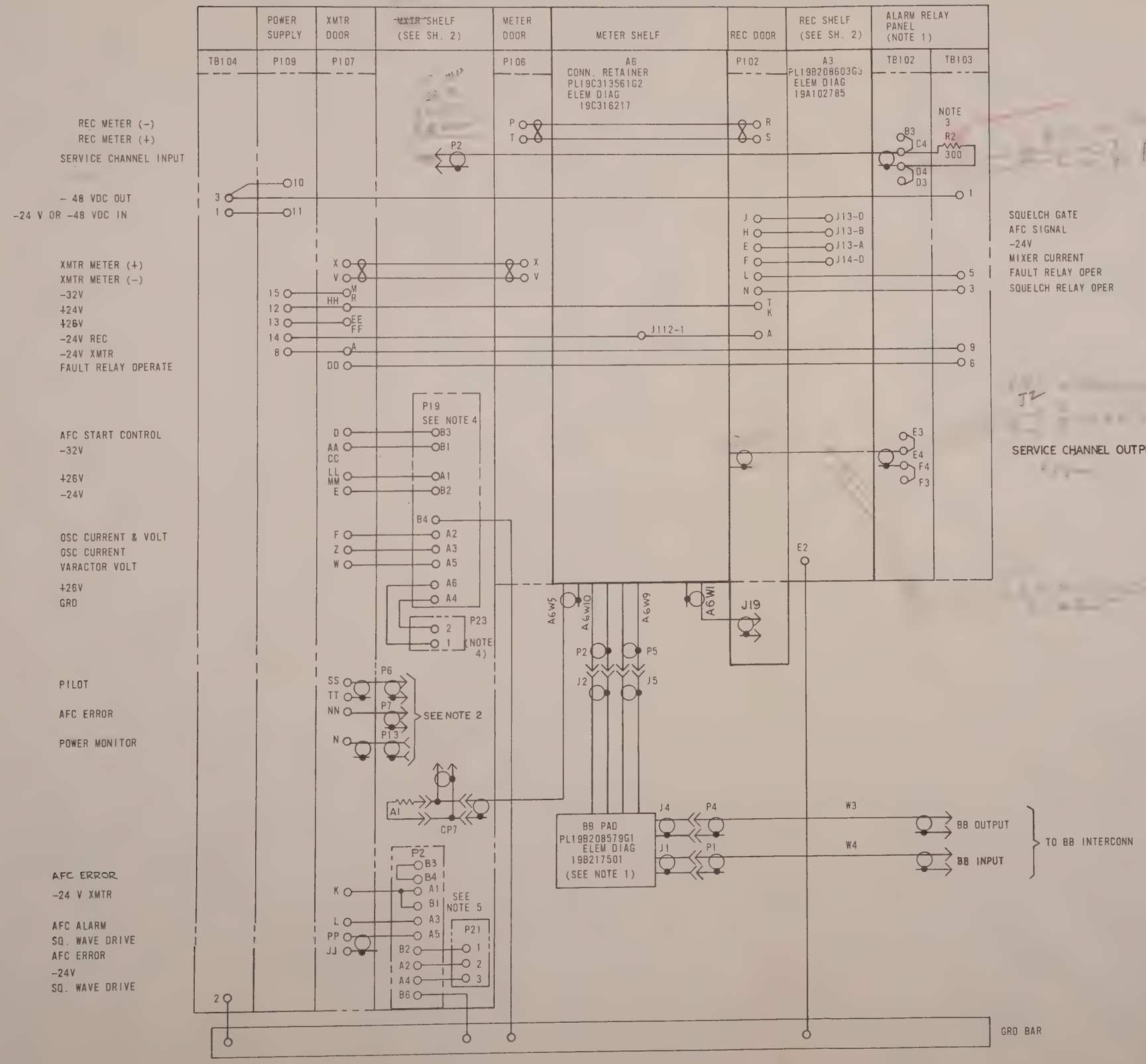
intercabling, wire
intercabling, RF



NOTE 1. ALARM RELAY PANEL AND BB PAD ARE SHOWN FOR REFERENCE ONLY. CONNECTIONS TO THESE UNITS ARE MADE AT RACK ASM.

2. P6 & P7 & P13 ARE CONNECTED TO J4 & J5 OF CRYSTAL AFC; AND J1 OF POWER MONITOR RESPECTIVELY ON THE XMTR WAVEGUIDE.

3. 300 OHM TERMINATION BETWEEN TB102-C4 AND TB102-D4 MUST BE REMOVED WHEN SERVICE CHANNEL IS CONNECTED.

4. P19 TO BE CONNECTED TO J1 OF XMTR RF OSC. P23 TO BE CONNECTED TO J3 OF POWER AMPLIFIER ON XMTR HEAT SINK.

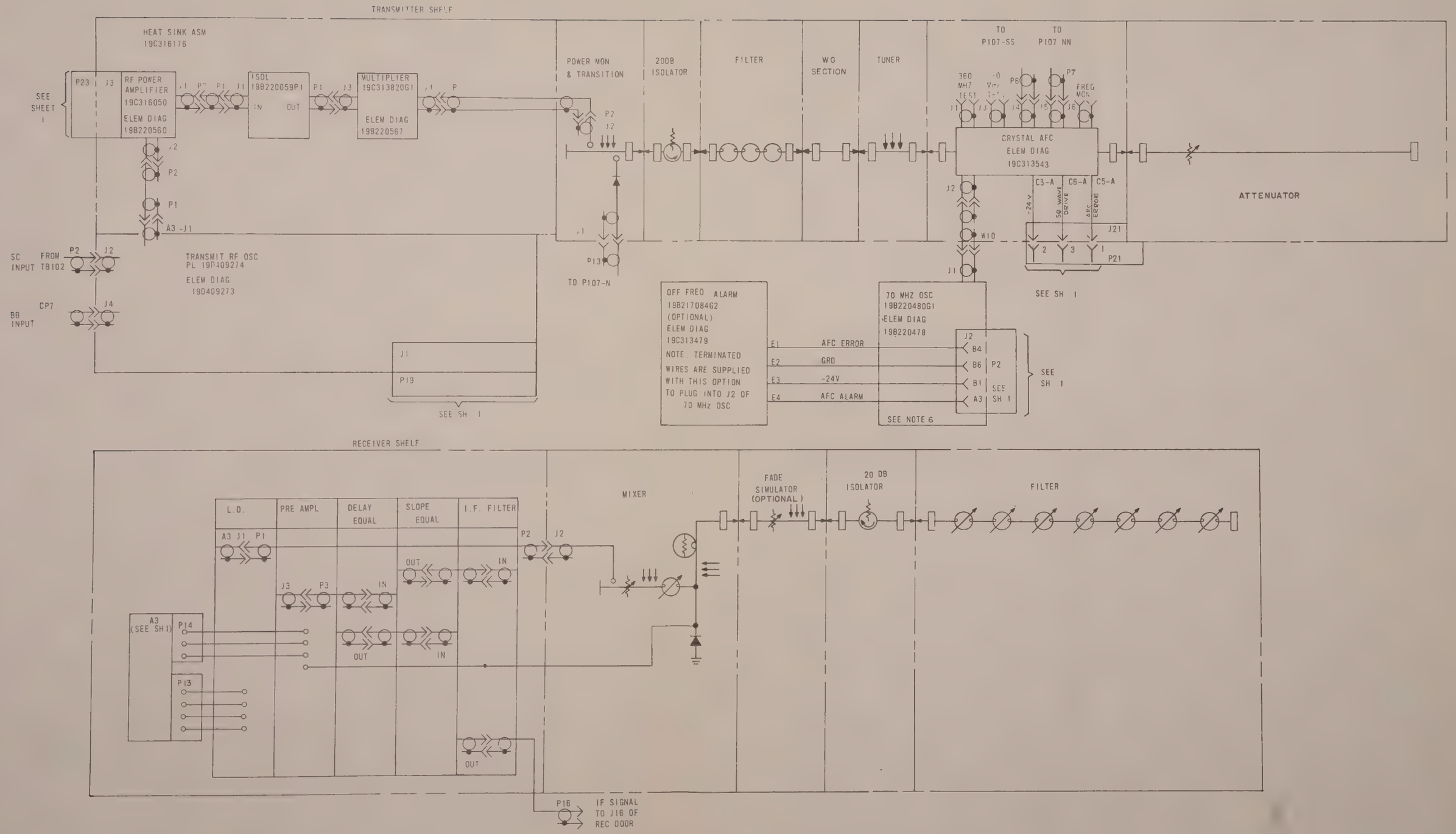
5. P2 IS CONNECTED TO J2 OF 70 MHz OSC. P21 IS CONNECTED TO J21 OF XTAL AFC.

6. THE 70 MHz OSC AND OFF FREQ. ALARM UNITS ARE LOCATED IN THE 2 RU SPACE BETWEEN 'B' XMTR BLANK DOOR AND 'A' POWER SUPPLY.

Interconnection Diagram

TRS-696B SOLID STATE BASIC
PL-19D405846-G11

(Drawing No. 19D409503, Sh. 1, Rev. 1)

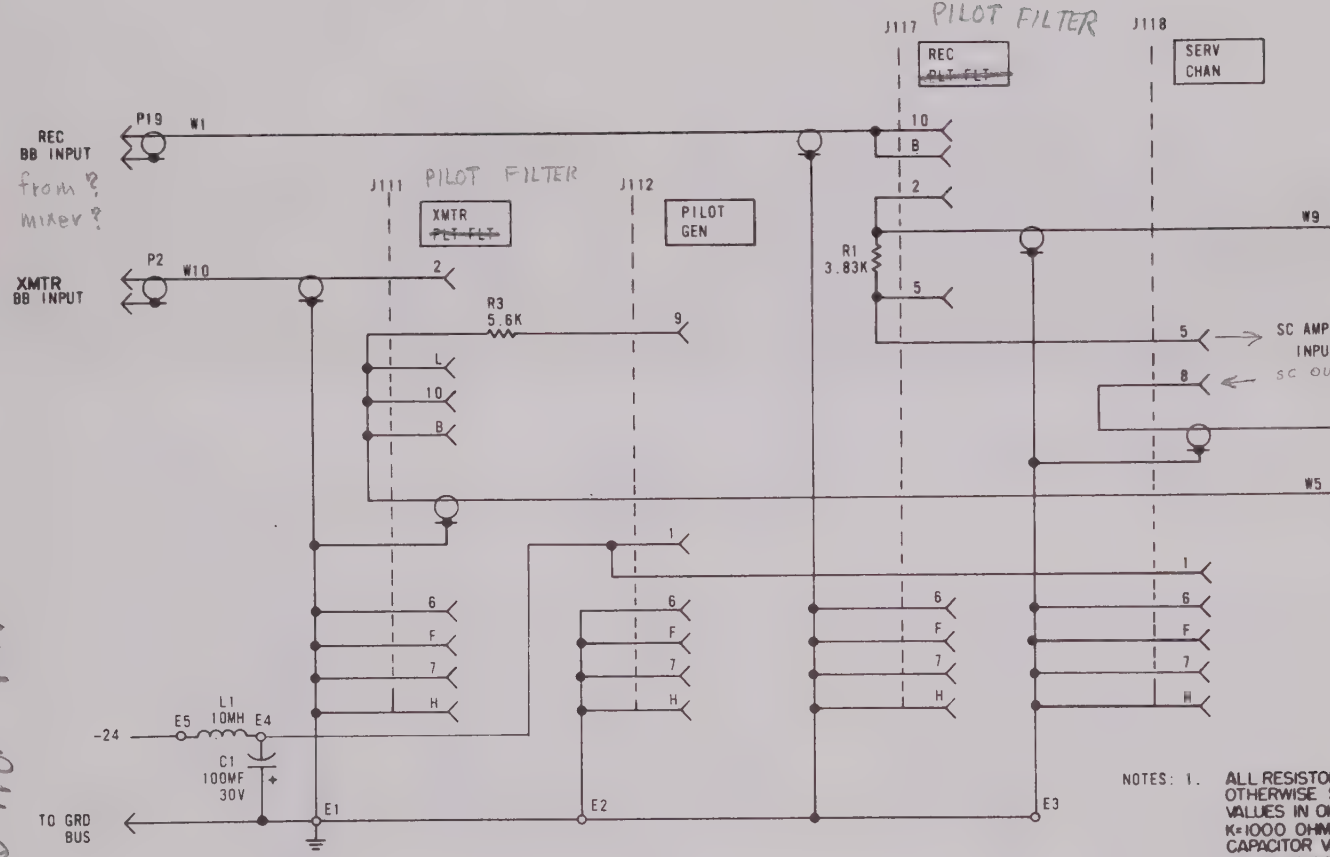


Interconnection Diagram

TRS-696B SOLID STATE BASIC

(Drawing No. 19D409503, Sh. 2, Rev. 0)

PILOT TONE



NOTES: 1. ALL RESISTORS ARE 1/2 WATT UNLESS OTHERWISE SPECIFIED AND RESISTOR VALUES IN OHMS UNLESS FOLLOWED BY K=1000 OHMS OR MEG=1,000,000 OHMS. CAPACITOR VALUES IN PICOFARADS (EQUAL TO MICROMICROFARADS) UNLESS FOLLOWED BY UF=MICROFARADS. INDUCTANCE VALUES IN MICROHENRYS UNLESS FOLLOWED BY MH=MILLIHENRYS OR H=HENRYS.

2. ▭ INDICATES FRONT PANEL MARKING

3. PINS 1 & A, 2 & B, 3 & C OF J111 & J117 ARE SHORTED TOGETHER WHEN PLUG-IN MODULE IS REMOVED

ALL PILOT RELATED

Elementary Diagram

CONNECTOR BANK
TRS-696 BASIC RACK

(Drawing No. 19C316217, Rev. 1)

BASEBAND BRIDGING NOTES

SYSTEM LEVELS

1. ALL LEVELS ARE DBM (75 OHMS) UNLESS OTHERWISE SPECIFIED
2. MULTIPLEX LEVELS ARE INDEPENDENT OF FREQUENCY.
3. BASEBAND BRIDGE AND RADIO LEVELS ARE INDEPENDENT OF FREQUENCY UNLESS EMPHASIS IS USED IN THE SYSTEM. FOR SYSTEMS WHICH USE EMPHASIS, THE BASEBAND BRIDGE AND RADIO LEVELS SHOWN CORRESPOND TO THE ZERO EMPHASIS FREQUENCY. FOR LEVELS AT OTHER FREQUENCIES, REFER TO EMPHASIS CURVE 19B211264.
4. THE SERVICE CHANNEL SEND AMPLIFIER IS ALWAYS SET FOR AN OUTPUT LEVEL OF 715 MV. A STRAPPING OPTION ON THE TRANSMITTER BASEBAND MATCHES THE SERVICE CHANNEL LEVEL TO AN EMPHASIZED BASEBAND.
5. TERMINAL RADIO SEND LEVEL IS SET AT -20 DBM (75 OHM) AS A STANDARD, HOWEVER, A STRAPABLE ATTENUATOR (INTERNAL TO THE RACK OR A UNIT MOUNTED IN THE INTERCONNECT SHELF) PROVIDES FOR SEND LEVEL VARIATIONS. IN THE EVENT THAT A TERMINAL RACK IS USED AS A LEG OF A MULTI-DIRECTION STATION, THE LEVEL TO BE USED IS SHOWN ON THE APPLICABLE MULTI-DIRECTION DIAGRAMS.
6. ATTENUATION OR AMPLIFICATION IS SHOWN ADJACENT TO THE ATTENUATOR OR AMPLIFIER.

SYMBOL IDENTIFICATION

* COAXIAL BARREL CONNECTOR

Δ JACKS ARE LOCATED ON THE ALARM PANEL EXCEPT DUAL BASIC JACKS J3 & J4 ARE LOCATED ON THE RACK ASSEMBLY

□ LEVELS WHICH ARE INDEPENDENT OF FREQUENCY, BUT ARE SET TO MATCH AN EMPHASIZED BASEBAND.

EQUIPMENT NOTES

W3 & W4 ARE A PART OF THE R F RACK WIRING

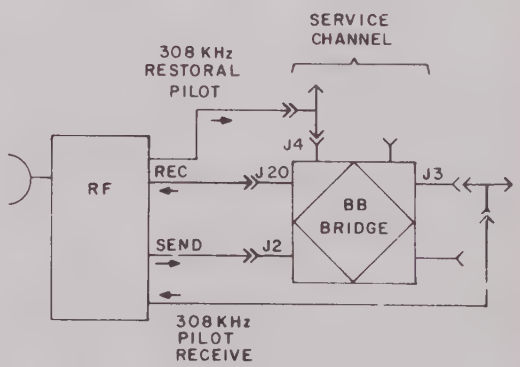
BRIDGING EQUIPMENT AND SERVICE CHANNEL EQUIPMENT ARE LOCATED IN THE SAME RACK UNLESS OTHERWISE NOTED. THIS RACK IS IDENTIFIED AS RACK 1.

RACK 2 IS IDENTIFIED AS THE HIGHEST TRANSMIT FREQUENCY OF RACKS OTHER THAN RACK 1, RACK 3 THE NEXT HIGHEST TRANSMIT FREQUENCY ETC.

W104 & W105 ARE SERVICE CHANNEL INPUT & OUTPUT CABLES WHEN THE RF RACK IS EQUIPPED WITH A SERVICE CHANNEL.

RETURN TO STOCK CABLES THAT ARE NOT REQUIRED

LOOP BASIC REPEATER PILOT CONNECTIONS ARE AS SHOWN BELOW

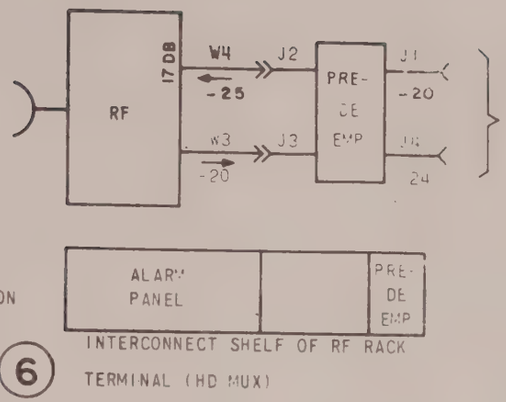


LOOP BASIC & DUAL LOOP BASIC APPLICATIONS: NON-REDUNDANT AUX AMPLIFIERS 19C313416G2 ARE CONNECTED IN SERIES WITH EQUALIZERS.

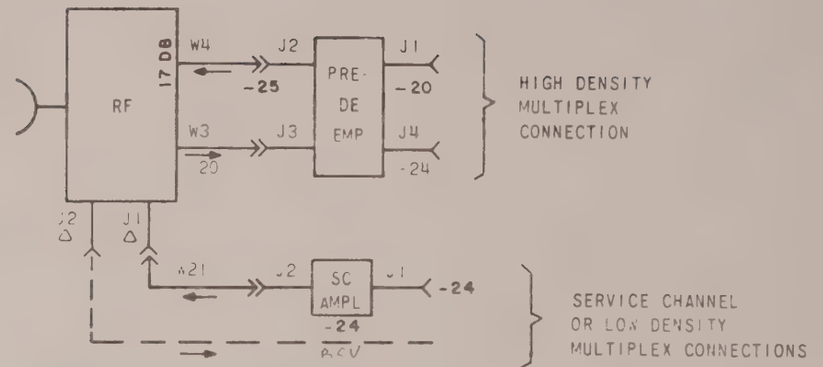
Functional Diagram

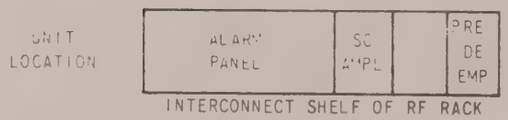
BASEBAND BRIDGING
PL-19B211234, 235 & 236

(Drawing No. 19C319020, Sh. 1, Rev. 4)

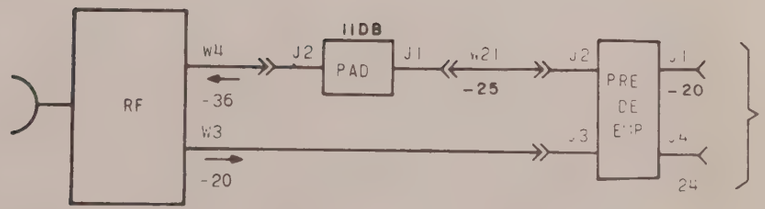


6 TERMINAL (HD MUX)

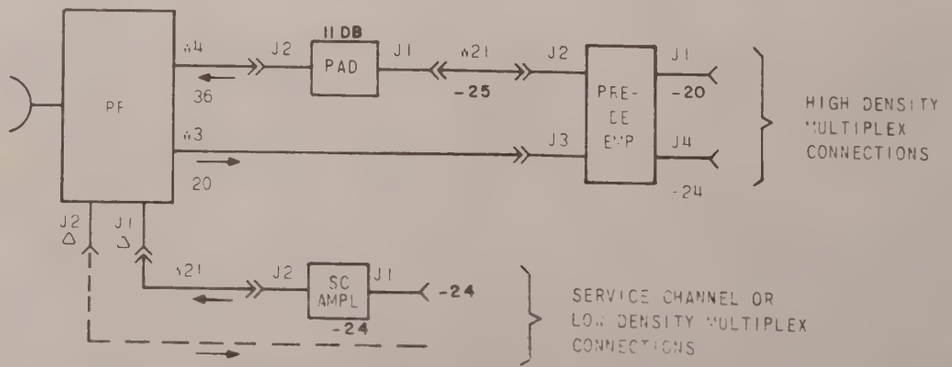


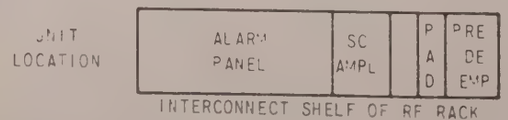


8 TERMINAL (SC. LD MUX & HD MUX)



7 TERMINAL (HD MUX)



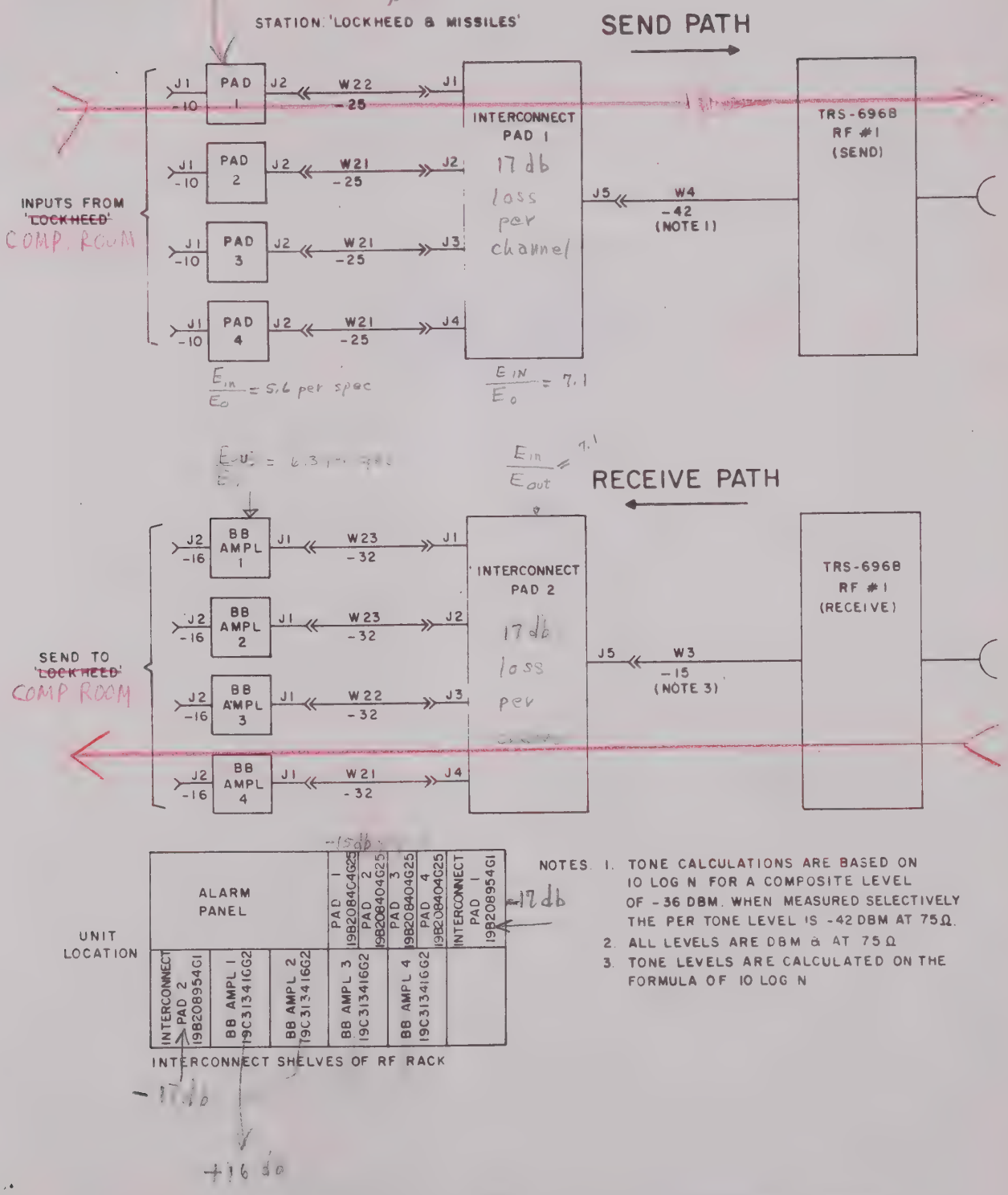


9 TERMINAL (SC LD MUX & HD MUX)

Functional Diagram

BASEBAND BRIDGING
TERMINAL STATION - SC/LD-HD MUX

(Drawing No. 19C319020, Sh. 2, Rev. 3)



NOTES:
1. TONE CALCULATIONS ARE BASED ON 10 LOG N FOR A COMPOSITE LEVEL OF -36 DBM. WHEN MEASURED SELECTIVELY THE PER TONE LEVEL IS -42 DBM AT 75Ω.
2. ALL LEVELS ARE DBM @ AT 75Ω
3. TONE LEVELS ARE CALCULATED ON THE FORMULA OF 10 LOG N

Functional Diagram

TRANSMISSION SYSTEM

(Drawing No. 19C322175, Rev. 1)

INSTRUCTION MANUAL

GENERAL ELECTRIC
DEVIATION CALIBRATOR
MODEL 4UZ24A1
PL-19D405883G1

ONLY

LBI-13904

TELECOMMUNICATION PRODUCTS DEPARTMENT
GENERAL ELECTRIC COMPANY
LYNCHBURG, VIRGINIA

Printed in U.S.A.

These instructions do not purport to cover all details or variations in equipment nor to provide for every possible contingency to be met in connection with installation, operation, or maintenance. Should further information be desired or should particular problems arise which are not covered sufficiently for the purchaser's purposes, the matter should be referred to the General Electric Company.

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SECTION I

INTRODUCTION AND LEADING PARTICULARS

1-1 DESCRIPTION

1-2 The General Electric Deviation Calibrator Model 4UZ24A1 is a self-contained portable test instrument used for calibration and adjustment of microwave radio equipment having receivers with 70 MHz IF strips (such as the General Electric TRS-696 and TRS-660 equipments.) The test set provides deviated test frequencies for low density coverage (70 to 75 MHz) and medium to high density message or video (65 to 75 MHz) applications, and in addition, can supply fixed CW signals of 65, 70 or 75 MHz singly or in combination (65 and 75 MHz or 70 and 75 MHz.) Solid state design is used, and the battery operated test set is fully enclosed in a compact aluminum case. All controls and the output connector are located on the front of the unit.

1-3 SPECIFICATIONS

Output frequencies:	CW: 65, 70, 75, 65 and 75, or 70 and 75 MHz; deviated: 65 to 75 or 70 to 75 MHz with 1.5 kHz modulation; tolerance ±0.005%.
Output level:	-7 ±1 dBm into 50-ohm load. This level can be lowered 10 dB by use of a built-in attenuator.
Power Supply:	Operating potentials are supplied by three 9-volt batteries contained within the unit; maximum current requirement is 17 ma.

SECTION II

OPERATION

2-1 CONTROLS

2-2 All controls are located on the front panel of the test set. Access to the panel is gained by loosening the captive bolts and removing the cover. A description of each control follows.

2-3 Frequency selection control: a six-position switch that serves as an on-off switch and a mode selector. Its positions are: OFF, 65 MHz, 70 MHz, 75 MHz, 70-75 MHz and 65 to 75 MHz.

2-4 Marker/deviation switch: a two-position selector switch labelled MARKERS and DEVIATION, that turns the 1.5 kHz modulator on or off when the frequency selector switch is in its 70-75 MHz or 65-75 MHz positions. The modulator is off when the switch is in its

MARKERS position and the two output frequencies appear at the output simultaneously; the modulator is on when the switch is in its DEVIATION position and the two frequencies appear at the output alternate succession at a 1.5 kHz rate.

2-5 10 dB attenuator switch: a two-position selector switch marked OUT and IN. When the switch is in the OUT position, the signal at the output is at the specified level; the signal at the output is 10 dB below specified level when the switch is in the IN position.

2-6 In addition to the three switch controls described above, there is a pair of test points and the signal output jack on the panel. The test points are marked BATTERY TEST; these are provided so the condition of the battery power supply can be monitored at the panel. The output signal is taken from a BNC jack marked OUTPUT.

2-7 APPLICATION

2-8 The primary purpose of the deviation calibrator is to measure and set the deviation sensitivity of microwave transmitters and receivers (receivers that have 70 MHz IF strips.) A calibration chart to be used as a guide when the instrument is being used for this purpose is fastened to the inside of the front cover. In addition, the test set may be regarded as a source of 65, 70 and 75 MHz signals which it can supply singly or in combination, CW or modulated. These various signals can be used as required for such applications as adjustment of receiver AFC and AGC, check of discriminator crossover, adjustment of transmitter AFC, and adjustment of sweep width for linearity and delay measurements. Refer to the appropriate instruction manual for specific applications on General Electric TRS-696 and TRS-660 equipments.

SECTION III

PRINCIPLES OF OPERATION

3-1 INTRODUCTION

3-2 The deviation calibrator consists of three crystal-controlled oscillators and an astable multivibrator that are connected into the configuration needed to provide the desired output by setting three switches. The crystal controlled oscillator circuit will be described first, and this will be followed by a description of the switching and multivibrator circuitry.

3-3 CRYSTAL-CONTROLLED OSCILLATOR CIRCUIT

3-4 The circuit configuration used for each of the three oscillators is shown on Elementary Diagram 19B217159. This circuit, constructed on a printed circuit board, consists of an oscillator and a buffer amplifier that can, if desired, be turned on and off by a pair of gating transistors.

3-5 Transistor Q1 is a crystal-controlled Colpitts oscillator. Oscillator frequency (65, 70 or 75 MHz) is determined by crystal Y1. The collector is tuned to this frequency by resonant circuit L2, C3, C4. Signal from the oscillator appears across the attenuator and gain control network formed by resistors R5 through R8 and potentiometer R16, and is coupled into the buffer amplifier through C5.

3-6 Transistor Q2 is the buffer amplifier. It is connected in the common base configuration with its output tuned to the oscillator frequency by L4, C8 and C9. Note that the output must be terminated by a resistive (50-ohm) load so there will be current through diode CR1; the signal will be blocked if there is no current through CR1. The buffer amplifier can be made to operate continuously, or it can be turned on and off by a pair of gating transistors.

3-7 Transistors Q3 and Q4 are the gating transistors. Transistor Q4 is turned off when the voltage at its base is at zero. This will cause the voltage at the base of Q3 to be sufficiently negative to make Q3 conduct. When Q3 conducts, bias circuit R9-R10-R11 for buffer amplifier Q2 is grounded through Q3 and the buffer amplifier is turned on. When the voltage at the base of Q4 is sufficiently negative to turn it on, the common point between resistors R12, R13 and R14 is grounded. This will cause Q3 to turn off and the bias circuit for Q2 is opened so the buffer amplifier is turned off. Thus it can be seen that the buffer amplifier is turned on when the voltage at the base of Q4 is zero and off when the base of Q4 is driven negative. The gating transistors are operated by the drive voltage applied to the base of Q4 through R15.

3-8 SWITCHING, MULTIVIBRATOR AND OUTPUT CIRCUITS

3-9 The three crystal-controlled oscillators are turned on and off and modulated as required by the switching and multivibrator circuits to produce the desired output. Refer to Elementary Diagram 19C313509.

3-10 Power is supplied by three 9-volt batteries (BT1, BT2 and BT3) connected in series to form a 27-volt source. This voltage can be checked by connecting a meter to the BATTERY TEST points on the panel. The positive side is grounded and the negative side is connected into selector switch S1-B. Switch S1-B determines which oscillator or combination of oscillators will be turned on. A description of the circuit for each position of S1 follows.

3-11 OFF (position 1)---The power circuit is open and the test set is inoperative when S1 is in this position.

3-12 65 MHz (position 2)---Power is applied to 65 MHz oscillator A1 through S1-B2 and TB1-2. Only the 65 MHz signal is present at OUTPUT jack J1.

3-13 70 MHz (position 3)---Power is applied to 70 MHz oscillator A3 through S1-B3 and TB3-2. Only the 70 MHz signal is present at OUTPUT jack J1.

3-14 75 MHz (position 4)---Power is applied to 75 MHz oscillator A2 through S1-B4 and TB2-2. Only the 75 MHz signal is present at OUTPUT jack J1.

3-15 70-75 MHz (position 5)---Power is applied via S1-B5 to MARKERS-DEVIATION switch S3 through diode CR1, to 70 MHz oscillator A3 through diode CR3 and TB3-2, and to 75 MHz oscillator A2 through diode CR4 and TB2-2. When switch S3 is in its MARKERS position, the 70 and 75 MHz signals appear at OUTPUT jack J1 simultaneously. When switch S3 is in its DEVIATION position, power is applied to the astable multivibrator (A4) which supplies square-wave drive signals to 75 MHz oscillator A2 through TB2-3 and to 70 MHz oscillator A3 through S1-A5 and TB3-3; the 70 and 75 MHz signals then appear at OUTPUT jack J1 in alternate succession.

3-16 65-75 MHz (position 6)---Power is applied via S1-B6 to MARKERS-DEVIATION switch S3 through diode CR2, to 65 MHz oscillator A1 through diode CR5 and TB1-2, and to 75 MHz oscillator A2 through diode CR6 and TB2-2. When switch S3 is in its MARKERS position, the 65 and 75 MHz signals appear at OUTPUT jack J1 simultaneously. When switch S3 is in its DEVIATION position, power is applied to multivibrator A4 which supplies square-wave drive signals to 75 MHz oscillator A2 through TB2-3 and to 65 MHz oscillator A1 through S1-A6 and TB1-3; the 65 and 75 MHz signals then appear at OUTPUT jack J1 in alternate succession.

3-17 The square-wave drive signals used to modulate the crystal-controlled oscillators are supplied by the astable multivibrator formed by transistors A4Q1 and A4Q2. When MARKERS-DEVIATION switch S3 is in its DEVIATION position and selector switch S1 is in either its 70-75 MHz or its 65-75 MHz position, power is applied to the circuit which will then oscillate at 1.5 kHz. Two outputs 180 degrees out of phase, the one from the collector of A4Q1 and the other from the collector of A4Q2, are taken from the circuit. The output from A4Q1 is connected into 75 MHz oscillator A2 at TB2-3. The output from A4Q2 is applied to 70 MHz oscillator A3 through S1-A5 and TB3-3, or to 65 MHz oscillator A1 through S1-A6 and TB1-3. Since the two signals are 180 degrees out of phase, it can be seen that 75 MHz oscillator A2 and either 70 MHz oscillator A3 or 65 MHz oscillator A1 (depending on the position of selector switch S1) will be gated on and off in alternate succession.

3-18 The three oscillator output terminals are connected to one side of the pad formed by resistors A4R9, A4R10 and A4R11. The other side of the pad is connected to OUTPUT jack J1 through switch S2 when this switch is in its OUT position. Signal level at OUTPUT jack J1 will then be the specified -7 ±1 dBm into a 50-ohm load; this level can be lowered 10 dB by putting switch S1 in its IN position to connect the pad formed by resistors R1, R2 and R3 in series with the output signal.

SECTION IV

MAINTENANCE

4-1 General mechanical features are shown on Pictorial Diagram 19D414146. Refer to Service Outline 19D414143 for details showing the location of all electrical parts.

4-2 The condition of the battery power supply can be checked by connecting a multimeter to the BATTERY TEST test points on the front panel.

4-3 The battery replacement procedure is as follows:

1. Remove the three screws holding the front panel.
2. The front panel along with the various subassemblies can now be removed from the housing.
3. Remove the retaining strip holding the batteries in place.
4. Disconnect plugs P1, P2 and P3 from the batteries.
5. Remove the three batteries and replace them with fresh batteries (Eveready No. 222 or equivalent.)
6. Connect plugs P1, P2 and P3 to the batteries.
7. Replace the retaining strip over the batteries.
8. Put the assembly back into the housing.
9. Replace the three screws in the front panel.

SECTION V

DRAWINGS AND PARTS LIST

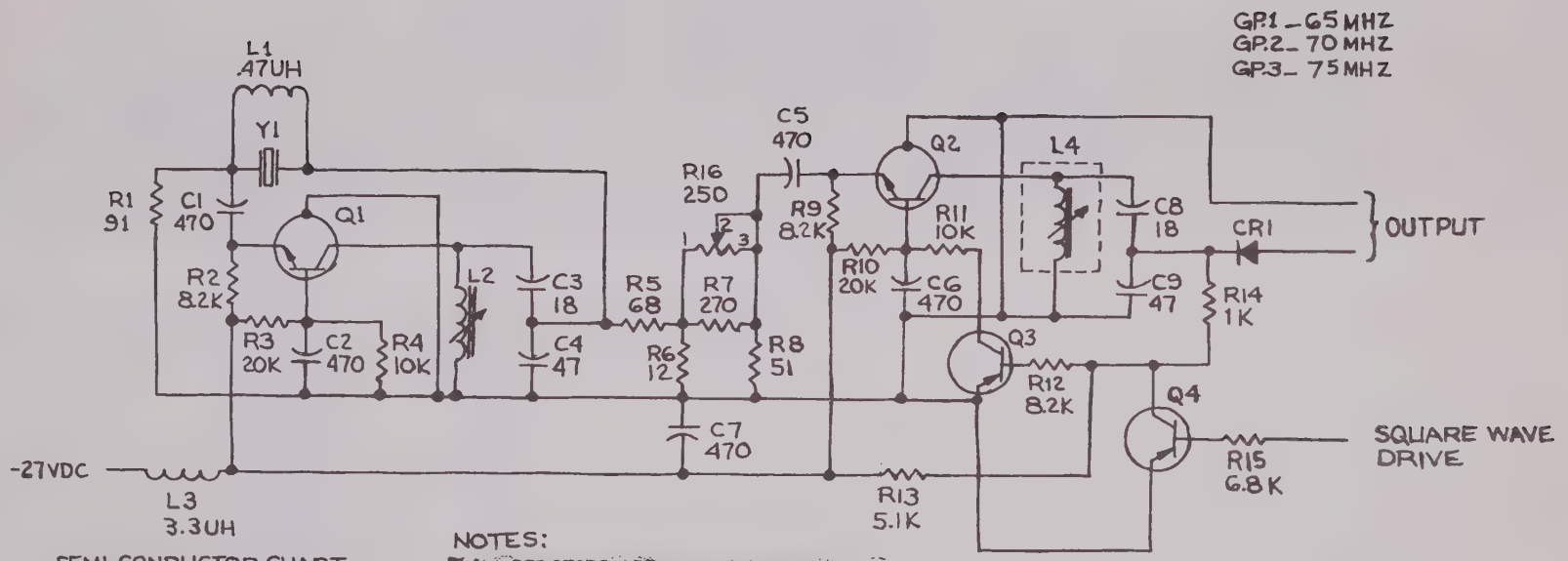
5-1 This section contains the drawings and parts list arranged in the order given below.

Oscillator Elementary Diagram	19B217159
Test Set Elementary Diagram	19C313509
Pictorial Diagram	19D414146
Service Outline	19D414143
Parts List	

Elementary Diagram

OSCILLATOR
PL-19B217158-G1 thru G3

(Drawing No. 19B217159, Rev. 2)



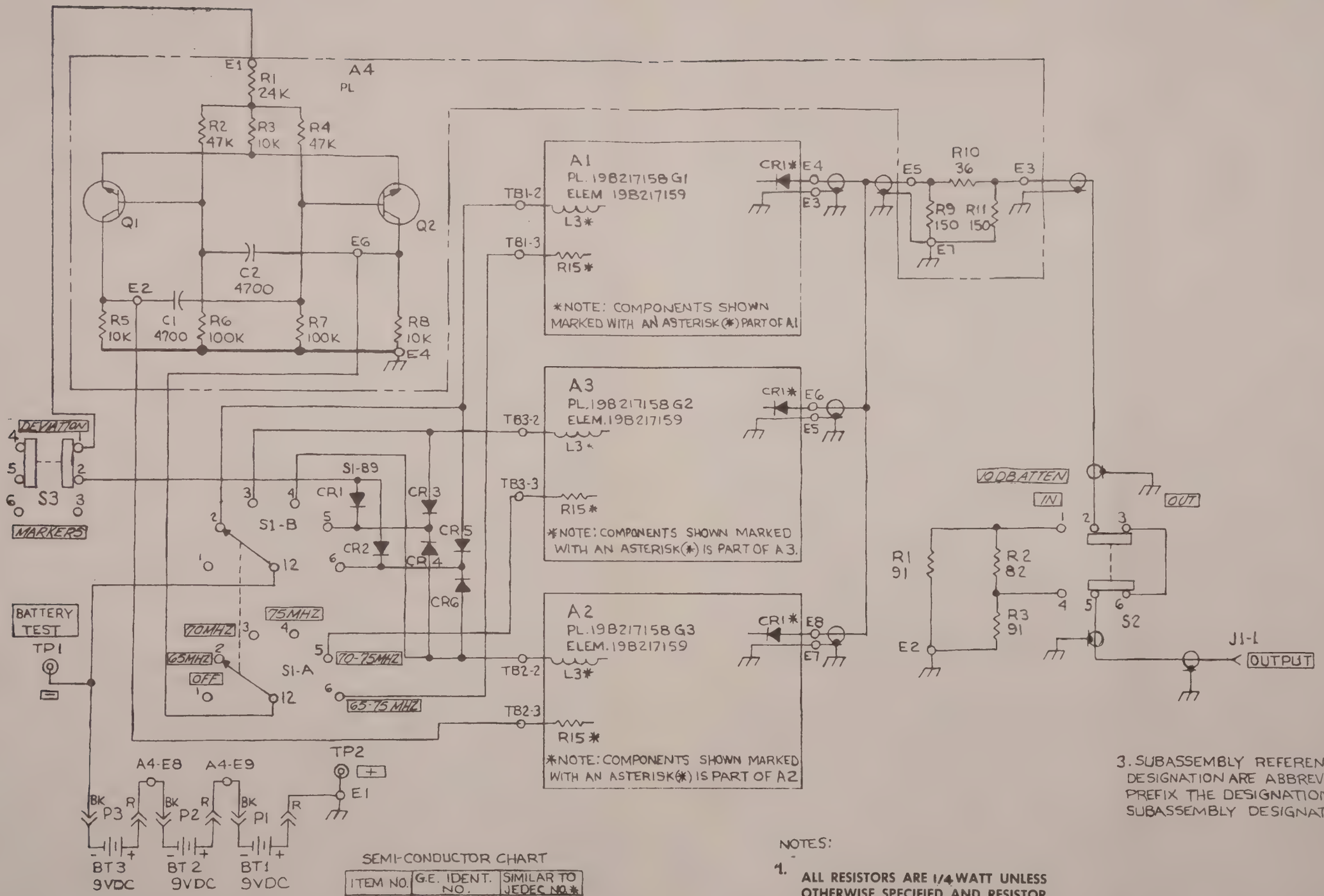
SEMI-CONDUCTOR CHART

ITEM NO.	GE IDENT. NO.	SIMILAR TO JEDEC NO. *
CR1	19A115250P1	
Q1, Q2	19A115440P1	
Q3, Q4	19A115768P1	2N3702

* FOR REFERENCE ONLY NOT RECOMMENDED FOR EXACT REPLACEMENT.

NOTES:

1. ALL RESISTORS ARE 1/4 WATT UNLESS OTHERWISE SPECIFIED AND RESISTOR VALUES IN OHMS UNLESS FOLLOWED BY K=1000 OHMS OR MEG=1,000,000 OHMS. CAPACITOR VALUES IN PICOFARADS (EQUAL TO MICROMICROFARADS) UNLESS FOLLOWED BY UF=MICROFARADS. INDUCTANCE VALUES IN MICROHENRYS UNLESS FOLLOWED BY MH=MILLIHENRYS OR H=HENRYS.



3. SUBASSEMBLY REFERENCE DESIGNATION ARE ABBREVIATED. PREFIX THE DESIGNATION WITH SUBASSEMBLY DESIGNATION.

SEMI-CONDUCTOR CHART

ITEM NO.	G.E. IDENT. NO.	SIMILAR TO JEDEC NO.*
CR1 & 2	19A115250 P1	
A4Q1 & A4Q2		

*FOR REFERENCE ONLY NOT RECOMMENDED FOR EXACT REPLACEMENT.

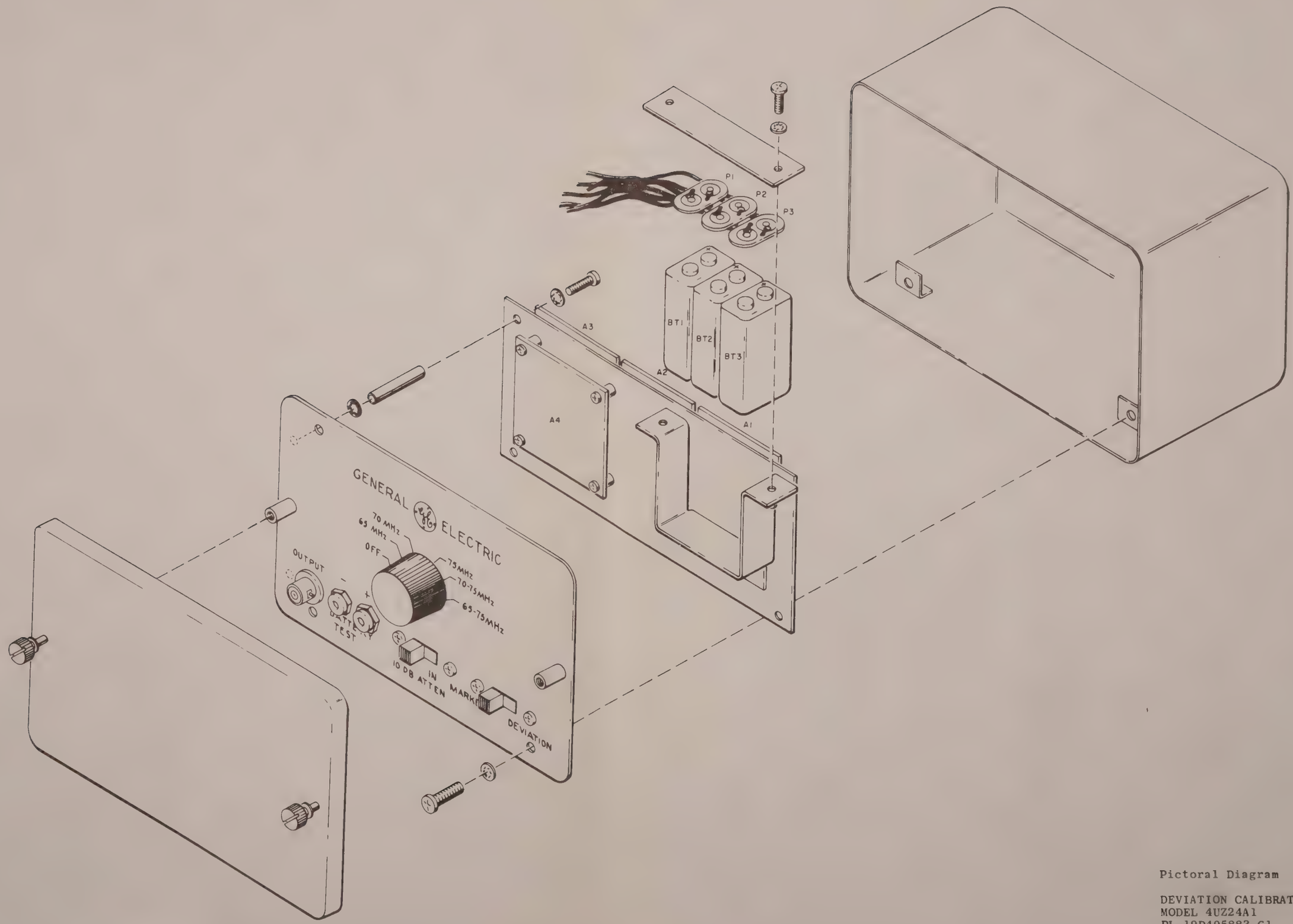
NOTES:

1. ALL RESISTORS ARE 1/4 WATT UNLESS OTHERWISE SPECIFIED AND RESISTOR VALUES IN OHMS UNLESS FOLLOWED BY K = 1000 OHMS OR MEG = 1,000,000 OHMS. CAPACITOR VALUES IN PICOFARADS (EQUAL TO MICROMICROFARADS) UNLESS FOLLOWED BY UF = MICROFARADS. INDUCTANCE VALUES IN MICROHENRYS UNLESS FOLLOWED BY MH = MILLIHENRYS OR H = HENRYS.
2. ▭ INDICATES FRONT PANEL MARKING.

Elementary Diagram

DEVIATION CALIBRATOR
MODEL 4UZ24A1
PL-19D405883-G1

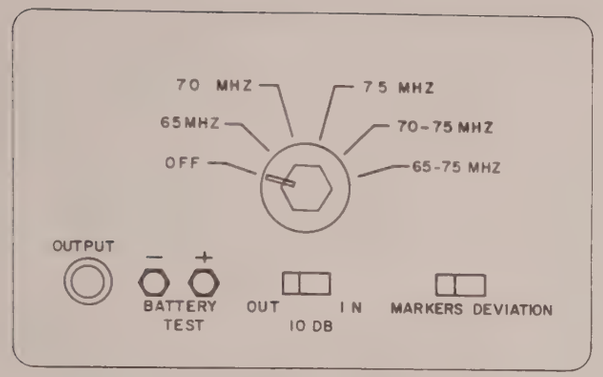
(Drawing No. 19C313509, Rev. 1)



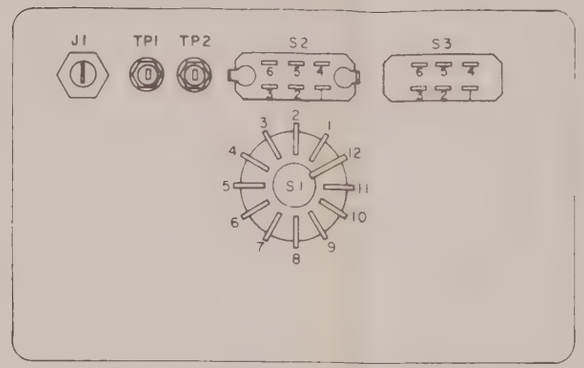
Pictoral Diagram

DEVIATION CALIBRATOR
MODEL 4UZ24A1
PL-19D405883-G1

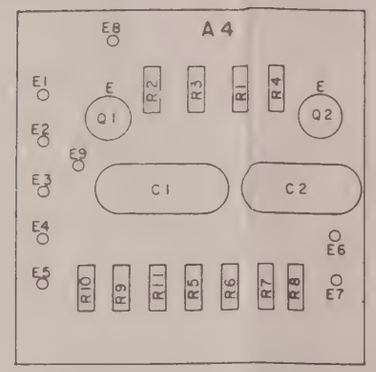
(Drawing No. 19D414146, Rev. 0)

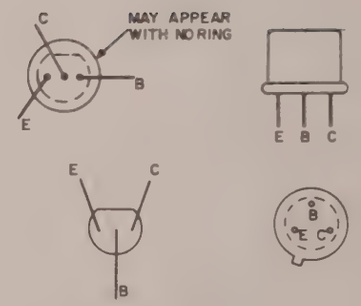


SHOWN WITH COVER REMOVED

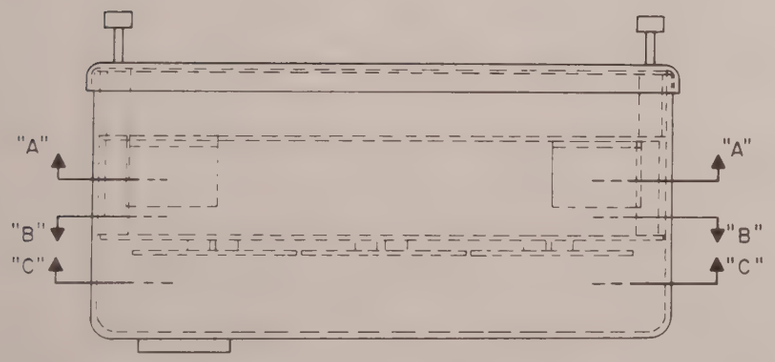


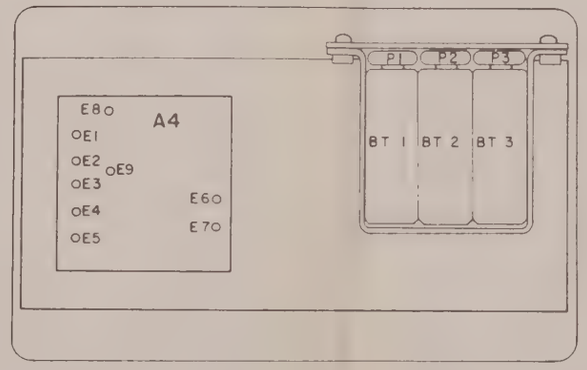
SECTION A-A



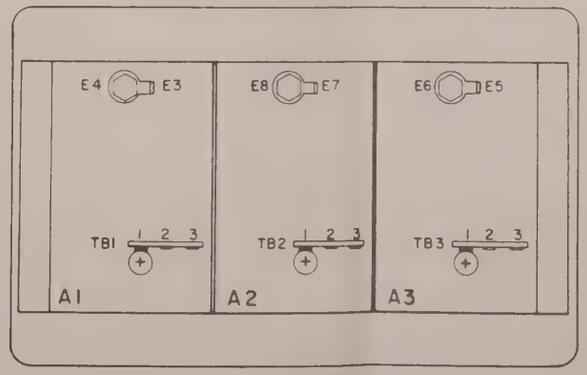


LEAD IDENIFICATION FOR Q1-Q4

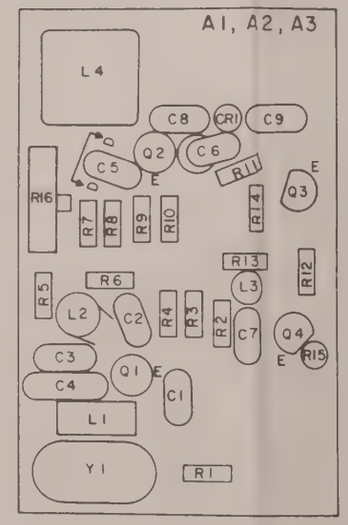


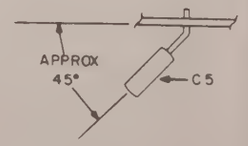


SECTION B-B

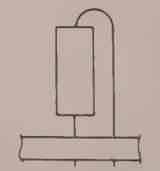


SECTION C-C





DETAIL AT D-D



FORMING & MOUNTING OF ALL STAND UP COMPONENTS

POLARITY FOR ALL STAND UP DIODES

Service Outline

DEVIATION CALIBRATOR
MODEL 4UZ24A1
PL-19D405883-G1

(Drawing No. 19D414143, Rev. 0

PARTS LIST

LBI-13904

DEVIATION CALIBRATOR
MODEL 4UZ24A1
19D405883-G1

SYMBOL	G-E PART NO.	DESCRIPTION
A1 thru A3		OSCILLATOR A1 19B217158-G1 A2 19B217158-G3 A3 19B217158-G2
		- - - - - - - - - - CAPACITORS - - - - - - - - - -
C1 and C2	5494481-P7	Ceramic disc: 470 pf ±20%, 1000 VDCW; sim to RMC Type JF Discap.
C3	5496218-P45	Ceramic disc: 18 pf ±5%, 500 VDCW, temp coef 0 PPM.
C4	5496218-P55	Ceramic disc: 47 pf ±5%, 500 VDCW, temp coef 0 PPM.
C5 thru C7	5494481-P7	Ceramic disc: 470 pf ±20%, 1000 VDCW; sim to RMC Type JF Discap.
C8	5496218-P45	Ceramic disc: 18 pf ±5%, 500 VDCW, temp coef 0 PPM.
C9	5496218-P55	Ceramic disc: 47 pf ±5%, 500 VDCW, temp coef 0 PPM.
		- - - - - - - DIODES AND RECTIFIERS - - - - - - -
CR1	19A115250-P1	Silicon.
		- - - - - - - - - - INDUCTORS - - - - - - - - - -
L1	7488079-P4	Coil, RF: 0.47 µh ±20%; sim to Jeffers 4411-4M.
L2	19B208961-G4	Coil: includes tuning slug 19B700497-P2.
L3	7488079-P10	Coil, RF: 3.30 µh ±10%; sim to Jeffers 4421-1K.
L4	19B208961-G3	Coil: includes tuning slug 19B700497-P2.
		- - - - - - - - - TRANSISTORS - - - - - - - - -
Q1 and Q2	19A115440-P1	Silicon, NPN.
Q3 and Q4	19A115768-P1	Silicon, PNP; sim to Type 2N3702.
		- - - - - - - - - - RESISTORS - - - - - - - - - -
R1	3R152-P910J	Composition: 91 ohms ±5%, 1/4 w.
R2	3R152-P822J	Composition: 8200 ohms ±5%, 1/4 w.
R3	3R152-P203J	Composition: 20,000 ohms ±5%, 1/4 w.
R4	3R152-P103J	Composition: 10,000 ohms ±5%, 1/4 w.
R5	3R152-P680J	Composition: 68 ohms ±5%, 1/4 w.
R6	3R152-P120J	Composition: 12 ohms ±5%, 1/4 w.
R7	3R152-P271J	Composition: 270 ohms ±5%, 1/4 w.
R8	3R152-P510J	Composition: 51 ohms ±5%, 1/4 w.
R9	3R152-P822J	Composition: 8200 ohms ±5%, 1/4 w.
R10	3R152-P203J	Composition: 20,000 ohms ±5%, 1/4 w.
R11	3R152-P103J	Composition: 10,000 ohms ±5%, 1/4 w.
R12	3R152-P822J	Composition: 8200 ohms ±5%, 1/4 w.
R13	3R152-P512J	Composition: 5100 ohms ±5%, 1/4 w.
R14	3R152-P102J	Composition: 1000 ohms ±5%, 1/4 w.
R15	3R152-P682J	Composition: 6800 ohms ±5%, 1/4 w.
R16	19B209358-P101	Variable, carbon film: 250 ohms ±10%, 1/5 w; sim to CTS Type X-201.

SYMBOL	G-E PART NO	DESCRIPTION
		- - - - - - - - - - SOCKETS - - - - - - - - - -
XY1	5490557-P2	Contact, crystal: (printed wiring), 4-fingers, brass. (Quantity 2).
		- - - - - - - - - - CRYSTALS - - - - - - - - - -
Y1	4036966-P2	Crystal: freq 65 MHz ±0.005%, temp range -20° to 75°C. (Used with A1 only).
	4036966-P3	Crystal: freq 75 MHz ±0.005%, temp range -20° to 75°C. (Used with A2 only).
	4036966-P1	Crystal: freq 70 MHz ±0.005%, temp range -20° to 75°C. (Used with A3 only).
A4		CONPONENT BOARD 19B217157-G1
		- - - - - - - - - - CAPACITORS - - - - - - - - - -
C1 and C2	4029003-P124	Mica: 4700 µf ±10%, 300 VDCW.
		- - - - - - - - - TRANSISTORS - - - - - - - - -
Q1 and Q2	19A115123-P1	Silicon, NPN; sim to Type 2N2712.
		- - - - - - - - - - RESISTORS - - - - - - - - - -
R1	3R152-P243J	Composition: 24,000 ohms ±5%, 1/4 w.
R2	3R152-P473J	Composition: 47,000 ohms ±5%, 1/4 w.
R3	3R152-P103J	Composition: 10,000 ohms ±5%, 1/4 w.
R4	3R152-P473J	Composition: 47,000 ohms ±5%, 1/4 w.
R5	3R152-P103J	Composition: 10,000 ohms ±5%, 1/4 w.
R6 and R7	3R152-P104J	Composition: 100,000 ohms ±5%, 1/4 w.
R8	3R152-P103J	Composition: 10,000 ohms ±5%, 1/4 w.
R9	3R152-P151J	Composition: 150 ohms ±5%, 1/4 w.
R10	3R152-P360J	Composition: 36 ohms ±5%, 1/4 w.
R11	3R152-P151J	Composition: 150 ohms ±5%, 1/4 w.
		- - - - - - - - - - BATTERIES - - - - - - - - - -
BT1 thru BT2	19A116133-P1	Battery, dry, carbon-zinc: 9 v; sim to Eveready 222 (NEDA 1604) Battery.
		- - - - - - - DIODES AND RECTIFIERS - - - - - - -
CR1 thru CR6	19A115250-P1	Silicon.
		- - - - - - - JACKS AND RECEPTACLES - - - - - - -
J1	7776570-P17	Receptacle, bulkhead: coaxial, 500 v peak. Military Type UG-1094/U.
		- - - - - - - - - - PLUGS - - - - - - - - - -
P1 thru P3	19A116299-P1	Terminal set, quick disconnect: sim to Cinch 5D.
		- - - - - - - - - - RESISTORS - - - - - - - - - -
R1	3R152-P910J	Composition: 91 ohms ±5%, 1/4 w.
R2	3R152-P820J	Composition: 82 ohms ±5%, 1/4 w.
R3	3R152-P910J	Composition: 91 ohms ±5%, 1/4 w.
		- - - - - - - - - - SWITCHES - - - - - - - - - -
S1	19C307127-P1	Rotary: 2 sections, 2 poles, 11 positions; sim to Aak Type "F".
S2 and S3	19A115004-P1	Slide: DPDT, 200 VDC at 15 ma, 12 VDC at 30 ma; sim to Oak Mfg 19640509.
		- - - - - - - - - TEST POINTS - - - - - - - - -
TP1	5490384-P2	Jack, tip: red nylon; sim to EF Johnson 105-252-1.
TP2	5490384-P3	Jack, tip: black nylon; sim to EF Johnson 105-253-1.

*COMPONENTS ADDED, DELETED OR CHANGED BY PRODUCTION CHANGES.

Chapter 4 Section I

PRINCIPLES OF OPERATION

TRS-696B TRANSMITTER

GENERAL

The TRS-696B Transmitter operates in the 6-7 GHz range. Its carrier is frequency modulated by the applied baseband and (optional) service channel signals. Power output is approximately one watt in the high power version (UT-10-C), and 0.25 watt in the low power version (UT-10-D). The transmitter consists of an rf oscillator, power amplifier, multiplier, a baseband amplifier, an AFC amplifier, a sensing unit (optional in the Basic configuration), and associated waveguide assemblies.

The transmitter is housed in a shelf with a swing-out door. The AFC amplifier, sensing unit and electrical controls for the rf oscillator are mounted on the door assembly. The rf oscillator chassis is mounted on the shelf. The rf power amplifier and multiplier are mounted on a heat sink attached to the rear panel.

SPECIFICATIONS

Power Output: Basic Configuration (deduct 1 dB for Standby)	
UT-10-C	+31.0 dBm without isoduplexer
	+30.6 dBm with isoduplexer
UT-10-D	+25.0 dBm without isoduplexer
	+24.6 dBm with isoduplexer
Frequency:	
PSIT Band	6575 to 6875 MHz
Frequency Stability:	±0.002%, -30°C to +55°C
Channel Capacity:	Up to 600 Channels (Single Sideband Suppressed Carrier)
Carrier Deviation: (FCC limitations)	200 kHz RMS - Up to 480 channels (single sideband suppressed carrier) with or without 3.2 MHz continuity pilot.
	150 kHz RMS - 600 channels (single sideband suppressed carrier) with or without 3.2 MHz continuity pilot.

Baseband Impedance:	75 ohms unbalanced
Baseband Level:	-42 dBm to -20 dBm adjustable in 1 dB steps
Operating Voltages:	
RF Oscillator	-28 Vdc at 275 mA
RF Amplifier	+26 Vdc ±0.5 Vdc
Baseband Amplifier	-24 Vdc at 130 mA
AFC Amplifier	-24 Vdc at 150 mA
Sensing Unit	-24 Vdc at 30 mA +24 Vdc at 5 mA

CONTROLS, INDICATORS AND TEST POINTS

METER SELECTOR: The meter selector switch is located on front of the transmitter door. It switches the rack meter (located on the meter panel in a Basic rack and on the Controller door in the Basic Expandable and Standby racks) into eight circuits to monitor functions bearing on transmitter operation. The functions monitored are:

OSC CUR	AFC
OSC V	VAR V
AMPL CUR	POWER
AMPL V	PILOT

AFC ZERO SET: The AFC zero set switch is located on front of the transmitter door. When this switch is depressed, the reading should be zero on the lower meter scale.

FAULT LIGHT: The fault light is located on front of the transmitter door. It is controlled by the sensing unit which monitors pilot level and transmitter power. Should either of these functions drop below a preset level, the light is turned on to indicate the presence of a fault.

POWER MONITOR: The power monitor control is located on the AFC control panel mounted on back of the transmitter door. This control is the load for the power monitor diode mounted in the waveguide. It provides a voltage proportional to power level to the sensing and metering circuits. At installation the power monitor control is set to obtain a red line reading on the meter.

AFC ZERO ADJUST: The AFC zero control is located on the AFC control panel mounted on back of the transmitter door. This control is used to provide a dc voltage to the AFC monitor circuit. It is adjusted to obtain a zero reading on the lower meter scale when the AFC zero set switch on the transmitter door is depressed.

VAR VOLT: This control provides bias adjustment for the modulator varactor; it is located on the AFC control panel mounted on back of the transmitter door.

AFC ON-AFC SET SWITCH: The AFC switch is located on the AFC control panel mounted on back of the transmitter door. It is used to open and close the AFC loop. The loop is open when the switch is in SET position, and closed when it is in ON position.

TP1, TP2, TP3: Three test points are located on the AFC control panel mounted on back of the transmitter door. TP1 is marked AFC ERROR, TP2 is marked GRD and TP3 is marked SQ WAVE DRIVE. The error signal from the crystal AFC can be monitored by connecting an oscilloscope to AFC ERROR (TP1) and GRD (TP2). The squarewave drive voltage supplied to the crystal AFC can be monitored by connecting an oscilloscope to SQ WAVE DRIVE (TP3) and GRD (TP2).

FREQUENCY MONITOR: Frequency monitor jack J6 is located on the transmitter waveguide. A wavemeter or a counter can be connected here to measure transmitter frequency. Power level is approximatley 5 milliwatts.

BASEBAND INPUT MONITOR: Input monitor test jack J3 and selector switch S1 are located on the rf oscillator chassis mounted on the transmitter shelf. When switch S1 is in its OPER position, baseband input signal can be checked by connecting a suitable high impedance instrument to J3. When S1 is in its TEST position, a test signal can be injected at J3, now a 75-ohm jack.

BASEBAND OUTPUT MONITOR: Output monitor jack J5 is located on the rf oscillator chassis mounted on the transmitter shelf. Baseband amplifier output can be monitored by connecting a suitable instrument to jack J5 (75 ohms).

FUNCTIONAL DESCRIPTION

The functional description of the transmitter is given in five parts: (1) transmitter oscillator circuit, (2) signal circuit, (3) crystal AFC, (4) fault sensing and (5) metering circuits.

TRANSMITTER OSCILLATOR

The transmitter rf oscillator consists of a resonant coaxial cavity and a transistor; refer to Elementary Diagram 19D409273. Two probes extend into the cavity, one being used to modulate the oscillator, and the other to couple rf power to output jack J1. The dc operating potentials required by transistor Y1-Q1 are brought in on two supply lines that pass through the cavity wall. Oscillator frequency is both mechanically and electrically adjustable. It is adjusted mechanically by varying the length of the cavity center conductor, and electrically by changing the bias applied to tuning varactor Y1-CV1.

The oscillator is frequency modulated by applying signal from the baseband amplifier to the tuning varactor through Y1-C5; the varactor is lightly coupled into the cavity by the probe. The modulated rf output is coupled to output jack J1 by the other probe.

SIGNAL CIRCUIT

Signal to be transmitted is applied to the baseband amplifier as shown on Elementary Diagram 19D409273. Two inputs are provided; the composite baseband input is applied to J4, and service channel signal (when this option is selected) is connected to J2. The baseband amplifier raises the signal (or signals) applied to it to the level required to modulate the rf oscillator. Its output, taken at J6, is applied to a tuning varactor in the rf oscillator through TB1-3 and feedthrough capacitor Y1-C5. The resultant frequency modulated rf signal is passed from the oscillator through harmonic absorber FL1 and isolator A3 to the rf power amplifier via A3-J1.

The rf power amplifier, an isolator and a multiplier are mounted on a heat sink fastened to the rear panel. Modulated rf signal is passed through each of these in the order given, and coupled into the transmitter waveguide. Refer to Interconnection Diagram 19D409270, Sh. 2 for Standby, to 19D409502, Sh. 2 for Basic Expandable, or to 19D409503, Sh. 2 for the Basic configuration.

Signal from the multiplier is coupled into the power monitor and transition section of waveguide through J2. A loop coupler and an associated detector mounted on this section provide a voltage proportional to power level for monitoring purposes through J1. The signal next passes through a waveguide isolator which prevents reflections originating in succeeding sections from returning to the multiplier. The signal is then passed through a filter, a second isolator (not used in the transmitter in a Basic rack), and a tuner to the crystal AFC section. The AFC section connects into the waveguide stack leading to the top of the rack. It is the AFC section that serves as the frequency reference for the AFC circuit that is covered in more detail in the crystal AFC description that follows.

CRYSTAL AFC

The crystal controlled AFC assembly is a part of the transmitter waveguide. The 360 MHz reference oscillator and IF discriminator are subassemblies enclosed in a shielded container fastened to the waveguide; the 70 MHz reference oscillator and the optional AFC crystal alarm are subassemblies enclosed in a shielded container located in the two rack unit space between transmitter "B" and power supply "A". Refer to Interconnection Diagram 19D409270, Sh. 2 for Standby, to 19D409502, Sh. 2 for Basic Expandable, or to 19D409503, Sh. 2 for the Basic configuration.

Transmitter energy is sampled by coupling it into the mixer/multiplier diode which is driven by the 360 MHz oscillator, and supplies an IF signal to the IF-discriminator where it is compared to a 70 MHz reference signal. If the two signals are the same frequency, the output from the discriminator will not deliver a signal to the AFC amplifier. If the frequencies are different, the output of the discriminator will be a squarewave error voltage whose amplitude is a function of the frequency difference. The error voltage

is applied to the AFC amplifier where it is used to change the varactor bias applied to the rf oscillator to correct transmitter frequency.

The AFC alarm is an optional unit used in conjunction with the crystal controlled AFC. It functions as an external alarm when the transmitter drifts beyond ±1 MHz of its assigned frequency. It is located inside the same inclosure as the 70 MHz oscillator.

FAULT SENSING

The fault sensing unit (optional in the basic configuration) monitors pilot tone content of the applied crystal AFC reference signal and rf power output. A fault will be indicated should either of these two monitored functions fall below a preset level. Refer to Elementary Diagram 19D409254.

The pilot tone content of the applied crystal AFC reference signal is monitored by applying signal to the sensing unit at J2-5. Transmitter rf power output is monitored by detecting signal in the power monitor and transition section of transmitter waveguide. The detector output is developed across POWER MONITOR control R5 on the transmitter door and is applied to the sensing unit at J2-9.

The sensing unit contains a tuned amplifier and two detectors for the pilot signal, an amplifier for the power level input and a level detector. The pilot tone is applied to two detectors. One detector provides a voltage proportional to pilot tone level to the metering circuit through J2-10. The output of the other detector is connected to the level detector. The voltage from the power monitor circuit is applied to J2-9, amplified and connected to the level detector. The gain of the pilot tone tuned amplifier and power monitor amplifier is adjustable. The gain of the respective amplifiers is adjusted so a level drop of about 6 dB in pilot, or 4.5 dB in power will result in a fault indication. The level detector is a Schmitt trigger circuit. A drop in tone or power level (as noted above) will cause it to change its end state to indicate a fault. The level detector circuit has three outputs: (1) an operating voltage to operate a fault relay is taken at J2-3, (2) a fault gate output is taken at J2-8, and (3) a voltage used to turn on the fault light on the transmitter door is taken at J2-1 and J2-2. Note that the sensing unit serves only to indicate the presence of fault: it does not identify which of the two monitored functions has faulted.

METERING CIRCUIT

Eight functions bearing on transmitter operation can be monitored by the metering system built into the rack. The meter is located on the meter panel in a Basic rack, and on the Controller door in a Basic Expandable or Standby rack. When its selector switch has been set to the XMTR position, the meter is connected to selector switch S1 on the transmitter door. A description of the circuit for each function follows. Refer to Elementary Diagram 19D409254.

OSC CURRENT (position 3): The rf oscillator/modulator current is monitored by connecting the meter, in series with A1-R5, across R5 of the regulator and AFC start module. The normal meter reading is red line +0, -6 large divisions.

OSC VOLTAGE (position 4): The rf oscillator/modulator operating voltage is monitored by connecting the meter, in series with A1-R4, to J7 on the regulator and AFC start module. The normal meter reading is 0.8 of red line ±2 large divisions.

AMPL CURRENT (position 5): Power amplifier current is monitored by connecting the meter, in series with A1-R1, across A1-R2. The normal meter reading is 0.8 of red line ±2 large divisions (UT-10-C only).

AMPL VOLTAGE (position 6): Power amplifier operating voltage is monitored by connecting the meter, in series with A1-R7, to the +26 Vdc line on component board A1. The normal meter reading is red line ±3 small divisions (UT-10-C only).

AFC (position 7): Resistor R6 and AFC ZERO control R7 form a voltage divider from -24 Vdc to ground. The negative side of the meter is connected to R7 through A1-R3. The positive side of the meter is connected to the AFC amplifier; it is connected to a chopper circuit at J3-2, and to the output of the error amplifier through AFC ZERO SET switch S3 and J3-4. When the ZERO SET Switch is depressed, the positive side of the meter is alternately connected to ground through the chopper transistor and to the voltage across the chopper load resistor. The meter is then connected to a fixed dc voltage on one side, and to the average of the voltage across the chopper load resistor on the other. With the ZERO SET switch depressed, the AFC ZERO SET control is adjusted to obtain a reading of zero on the lower meter scale. When the ZERO SET switch is in its normal (closed) position, the output of the error amplifier appears across the chopper load resistor. If the output of the error amplifier goes positive as the chopper transistor is turned on, only the negative half cycles appear across the load resistor. Conversely, when the output of the error amplifier goes negative as the chopper is turned on, only the positive half cycles appear across the load resistor. The average voltage developed across the chopper load resistor will be either in series aiding or series oposition to the fixed dc voltage applied to the negative side of the meter. Depending on the phase of error amplifier output relative to chopper bias, the meter will read up-scale or down-scale from its zero center position by an amount proportional to the amplitude of the error signal. When the AFC is operating properly and the transmitter is being held on frequency, the meter will read zero on the lower scale.

VARACTOR VOLTAGE (position 8): Voltage applied to the varactor in the rf oscillator/modulator is monitored by the emitter-follower circuit comprised of A1-R9, A1-CR1, A1-Q1 and A1-R6. The meter, in series with A1-R8, is connected to the emitter of A1-Q1. The normal meter reading is 0.6 of red line ±1 large division.

POWER (position 9): Transmitter power is monitored by connecting the meter, in series with A1-R10, to the wiper of PWR MON control R5. Initially, the PWR MON control is adjusted to obtain a red line meter reading.

PILOT (position 10): Transmitter pilot level is monitored by connecting the meter across the output of the pilot detector in the transmitter sensing unit. The sensing unit is adjusted to obtain a red line meter reading for the normal condition.

TELECOMMUNICATION PRODUCTS DEPARTMENT
GENERAL ELECTRIC COMPANY
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TRANSMITTER MAINTENANCE
TRS-696B (PSIT BAND)

GENERAL

Transmitter maintnance is divided into four major parts consisting of: (1) visual inspection, (2) controls and indicators, (3) rack metering, and (4) inservice checkout and adjustment. Troubleshooting and field tuning procedures are given in LBI-16054. Removal and replacement procedures are given in LBI-16055.

VISUAL INSPECTION

A visual inspection of the transmitter should include the following:

(1) When power plugs or coaxial cables are disconnected for maintenance purposes, always check for loose or damaged pins and shorted shield wires before replacing.

(2) Be sure ground wire from transmitter door is securely connected to rack ground bus.

(3) On both plug-in circuit cards, be sure the flags on the cards and the mating connector on the transmitter door are not physically damaged.

CONTROLS AND INDICATORS

The controls and indicators that are referenced in the inservice checkout and adjustment procedures are listed in Figure 1.

USE OF METERING CIRCUITS

Eight functions bearing on transmitter operation can be monitored by the metering system built into the rack. By sequentially selecting each function, an analysis of transmitter operation can be made and generally a malfunction can be localized. The monitored functions are listed in Figure 2 along with their normal indications. Also, the possible faulted unit(s) when an abnormal indication is present is identified.

TRANSMITTER INSERVICE CHECKOUT AND ADJUSTMENT PROCEDURES

The inservice checkout procedures check out a transmitter operating in either diversity or working standby configurations without interrupting traffic. The only exception occurs when a basic configuration is used and then only when performing the linearity adjustment or the transmitter baseband gain procedures.

CONTROL/INDICATOR	DESIGNATION	LOCATION	FUNCTION
FAULT Lamp	DS1	Transmitter Door	Indicates pilot or power has dropped below a preset level
METER SELECTION	S1	Transmitter Door	Provides for performance monitoring of transmitter functions and voltages on the rack meter. Switch positions are as follows: (1) SPARE (2) SPARE (3) OSC CUR (4) OSC V (5) AMPL CUR (6) AMPL V (7) AFC (8) VAR V (9) POWER (10) PILOT (11) SPARE (12) SPARE
VAR VOLT (modulating the varactor voltage adj.)	R2	Transmitter Door--AFC Control Panel	Provides bias adjustment for the modulator varactor.
AFC ON-SET	S4	Transmitter Door--AFC Control Panel	AFC SET: opens AFC loop AFC ON: closes AFC loop.
POWER MONITOR	R5	Transmitter Door--AFC Control Panel	Provides a variable reference voltage proportional to output power.
AFC ZERO	R7	Transmitter Door--AFC Control Panel	Varies AFC reference point
AFC ZERO SET	S3	Transmitter Door	Provides disconnect for meter output from AFC amplifier to zero meter. Used in conjunction with AFC zero adjust, R7.

Figure 1. Controls and Indicators
(Sheet 1 of 2)

CONTROL/INDICATOR	DESIGNATION	LOCATION	FUNCTION
OPER/TEST	S1	Transmitter RF Oscillator	Selects either input monitor or test position INPUT MON position: Connects baseband input signal to transmitter baseband amplifier and to test jack J3 TEST input position: Disconnects baseband input signal from transmitter baseband amplifier and terminates test input in 75 ohms.
RF Oscillator Frequency Tuning Screw		Transmitter RF Oscillator	Manual adjustment for changing operating frequency of RF Oscillator
RF Coupling Adjustment		Transmitter RF Oscillator	Adjustment for maximum power output
Pilot Meter Adjust	R20	Fault Sensing Unit	Adjusts meter reference level
Pilot Receiver Gain Adjust	R1	Fault Sensing Unit	Sets the minimum input level at which a pilot fault occurs
S1	S1	70 MHz OSC	Provides for measurement of the 70 MHz IF at the 70 MHz test jack, J3
S2	S2	70 MHz OSC	Provides for measurement of the 70 MHz reference at the 70 MHz test jack J3

Figure 1. Controls and Indicators
(Sheet 2 of 2)

FUNCTION	NORMAL METER INDICATIONS	POSSIBLE FAULTED UNIT
Osc. Current	Red line +0, -6 major divisions	Power supply; Regulator board; RF oscillator transistor.
Osc. Voltage	0.8 red line ±2 major divisions	Power supply; Regulator board.
Amp. Current	0.8 red line ±2 major divisions. (UT-10-C only)	Power supply; RF amplifier transistor
Amp. Voltage	Red line ±3 small divisions. (UT-10-C only)	Power supply
Var. Voltage	0.6 of red line ±1 major divisions	Transmitter door AFC control panel; power supply; modulator varactor; (check operating frequency before making any adjustments)
AFC	Zero on lower scale	Crystal AFC; AFC amplifier
Power	Red line	Power monitor diode; transmitter sensing unit; RF oscillator; RF amplifier; multiplier; power supply
Pilot Level	Red line	Transmitter sensing unit; baseband amplifier; pilot oscillator; S1 (on transmitter RF oscillator chassis) in TEST position

TEST POINTS

CRYSTAL AFC DRIVE TP3:	Square wave 5.5 ±0.5 volts peak-to-peak
AFC ERROR TP1:	Square wave whose amplitude is proportional to frequency error and whose polarity is indicative of direction of frequency drift with reference to crystal AFC
INPUT MON/ TEST INPUT Jack (J3):	Monitors baseband input signal to transmitter baseband amplifier. Refer to initial adjustments for correct levels
OUTPUT MON Jack (J5):	Monitors baseband output level of transmitter baseband amplifier. Refer to initial adjustments for correct levels

Figure 2. Meter Functions and Indications

TEST EQUIPMENT	PROCEDURE						
	TRANSMITTER FREQUENCY	TRANSMITTER POWER	TRANSMITTER BASEBAND GAIN	TRANSMITTER LINEARITY	RF OSCILLATOR LINEARITY	FAULT SENSING	TRANSMITTER AFC
Oscilloscope (Tektronix 531)				X	X		X
Preamplifier (Tektronix Type CA)				X	X		
Distortion Measuring Set (ITT 74 8445C)				X	X		
Frequency Selective Voltmeter						X	

Figure 3. Test Equipment Required (or equivalent) (Sheet 1 of 2)

Individual checkout procedures may be performed in any sequence desired; however, if a complete checkout is to be accomplished, they should be performed in the sequence given. Prior to performing the inservice checkout procedures assure that system traffic will not be interrupted. This is accomplished as follows:

For Working Standby and Space Diversity racks---on the controller shelf: set MANUAL SELECTOR switch on the transmitter memory unit to A operate (upper) position when transmitter B is being serviced and to B operate (lower) position when transmitter A is being serviced. Depress and tape down the waveguide plunger on the transmitter being serviced.

The test equipment required to perform single rack inservice checkout procedures are listed in Figure 3 along with the procedure for which they are used.

TEST EQUIPMENT	PROCEDURE						
	TRANSMITTER FREQUENCY	TRANSMITTER POWER	TRANSMITTER BASEBAND GAIN	TRANSMITTER LINEARITY	RF OSCILLATOR LINEARITY	FAULT SENSING	TRANSMITTER AFC
Frequency Counter (Systron Donner 1017)	X						X
RF Voltmeter (HP-411A)							X
Waveguide-to-Coaxial Cable Adapter (HP-J281A)		X					
Electronic Counter (HP-5246L)							X
Power Bridge (HP-431A)		X					X
360 MHz Head (HP-5254B)							X
Thermistor Mount (HP-478A)		X					
Termination (HP-908A)							X
Adapter "Tee", BNC			X(3)	X	X		X
Tee Probe Tip (HP-11024A)							X
Adapter, BNC (F) to TNC (M)			X	X			
VOM (Triplett 630)							X
Test Oscillator (HP-651B-02)			X				
Test Set (GE 4UZ24A1)				X	X		X
Ac Voltmeter (HP-400EL)			X				
Attenuator (0-50 dB)			X	X	X		
Connector BNC Modified (GE-A4037636G4)			X				
Termination 75 ohm BNC			X				

Figure 3. Test Equipment Required (or equivalent) (Sheet 2 of 2)

CAUTION

Solid state rf devices can be easily damaged by improper handling. Particular caution should be exercised during the following operations:

(1) DC Connection - Turn the power supply off before connecting or disconnecting dc power connectors on transmitter units, doors and assemblies.

(2) RF Connection - Turn the power supply off before connecting or disconnecting rf coaxial connectors to transmitter rf units.

(3) RF Amplifier -

A. The rf amplifier should NEVER be operated with its output unterminated (output isolator removed).

B. The rf amplifier should NEVER have rf power applied to its input in the absence of dc power (+26 volts).

(4) RF Oscillator -

A. The rf oscillator should never be operated with its output unterminated (output isolator removed).

B. If during frequency tuning or linearization, the rf oscillator loses its power (stops oscillating), turn the power supply off immediately. The rf oscillator will not restart itself, the power supply must first be turned off, then on before the rf oscillator will restart.

TRANSMITTER FREQUENCY

(1) Open the transmitter door and on the AFC control panel, set the AFC ON-AFC SET switch to AFC SET.

(2) Set the OPERATE/TEST switch on the transmitter rf oscillator chassis to its TEST position.

(3) Set the meter selector switch on transmitter door to VAR V. Observe the rack meter and, if necessary, adjust R2 (VAR VOLT) for the meter indication stamped on the transmit rf oscillator chassis.

(4) Connect frequency counter to jack J6 on crystal AFC unit. If necessary, set rf oscillator mechanical frequency adjust

for a transmitter frequency within ±500 kHz of the assigned frequency marked on the transmitter nameplate.

(5) Set the AFC ON-AFC SET switch to AFC ON. Measure transmitter frequency.

NOTE

Transmitter frequency should be within 0.002% of assigned frequency marked on transmitter nameplate.

(6) If transmitter frequency is not within tolerance, adjust AFC using the procedure given in the TRANSMITTER AFC section; if still outside of tolerance, replace crystal AFC using the procedure given in the CRYSTAL CONTROLLED AFC section of LBI-16055.

(7) Disconnect frequency counter from jack J6.

(8) Repeat procedure for transmitter B.

(9) Return rack to normal operating status.

TRANSMITTER POWER

CAUTION

Before connecting the power bridge, be certain of the coupling factor (marked on the crossguide coupler) and the proper scale setting to use. The thermistor mount may be damaged if input power exceeds 10 mW.

(1) Connect the power bridge (HP-431A) and thermistor (HP-478A) to the adaptor on the crossguide coupler.

(2) (Basic Rack) Remove cover from the crossguide coupler (top of rack) and install the waveguide-to-coaxial cable adaptor.

NOTE

Transmitter output power will be the algebraic sum of the meter reading and the coupling factor. Example: coupling factor 30 dB; meter reading +1.5 dBm; the power output is:

+1.5 + 30 = +31.5 dBm.

(3) Measure and record output power of transmitter. Minimum outputs should be as follows:

Standby and Space Diversity---

UT-10-C with isoduplexer	+29.6 dBm
UT-10-C without isoduplexer	+30.0 dBm

UT-10-D with isoduplexer	+23.6 dBm
UT-10-D without isoduplexer	+24.0 dBm

Basic - -

UT-10-C with isoduplexer	+30.6 dBm
UT-10-C without isoduplexer	+31.0 dBm
UT-10-D with isoduplexer	+24.6 dBm
UT-10-D without isoduplexer	+25.0 dBm

NOTE

Operating transmitter is indicated on the front of the controller door.

(4) (Working Standby and Space Diversity Configuration) Measure and record output power of transmitter being serviced. Switch transmitter memory unit to select opposite transmitter, measure and record output power.

(5) Remove the waveguide-to-coaxial adapter and replace the crossguide coupler cover.

(6) Return the rack to normal operating status.

TRANSMITTER BASEBAND GAIN

NOTE

A good indication of transmitter baseband gain can be obtained by using the rack meter to monitor pilot signal. Turn the METER SELECTOR on the controller panel to one of its XMTR positions, and the METER SELECTOR on the corresponding transmitter to PILOT. If a red line meter indication is obtained, baseband gain may be considered properly adjusted.

If necessary, transmitter baseband gain can be checked as outlined below. On TR/R diversity racks, perform steps 2 through 12 only.

(1) Open the controller door and place the transmitter memory unit selector switch in its B OPERATE (lower) position.

(2) Place the receiver baseband logic unit selector switch in its B OPERATE (lower) position.

(3) Open the A transmitter door and place the OPERATE/TEST switch on the rf oscillator chassis in its TEST position.

(4) Connect a signal generator to the TEST INPUT of the rf oscillator chassis using RG59-BU cable. Bridge an unterminated AC VTVM directly onto the test cable.

(5) Set the generator frequency to 300 kHz and the generator level to 12.2 mV. Disconnect the AC VTVM.

NOTE

If the radio equipment is to operate at the special test tone input level of -45 dBm (rather than the standard -42 dBm, set the generator level to 8.7 mV.

(6) Open the A receiver door and disconnect the cables at J16 (IF input) and J19 (baseband output) on the door. Connect a 75-ohm terminated AC VTVM to J19 using RG59-BU cable.

(7) Connect J16 on the A receiver door to the J3 BNC connection (IF test) on the A transmitter waveguide-mounted AFC unit using a six-foot length of RG58-AU cable.

(8) Note the AC VTVM indication. It should be 6 dB below (1/2) the level given in Table I for modulation and continuity pilot conditions listed.

NOTE

For most applications using the standard -20 dBm test tone output, the Table I level is 154 mV. The step 8 meter indication should therefore be 77 mV. Table I lists levels for other test tone level conditions.

(9) If necessary, adjust the GAIN ADJ control on the transmitter baseband amplifier to obtain the correct indication.

(10) While monitoring the AC VTVM, depress the pushbutton switch S1 (red) on the transmitter 70 MHz reference oscillator unit. The meter indication should be at the Table I listed value (154 mV for the standard -20 dBm test tone output level). Release the switch.

(11) If the step 10 meter indication is not at the correct level, adjust the GAIN ADJ control as necessary as per step 9.

NOTE

Prolonged depression of switch S1 can result in transmitter frequency drift and a possible change in the meter indication.

(12) Disconnect all test equipment. Reconnect the cables to J19 and J16 on the A receiver door. Place the A transmitter rf oscillator chassis switch in its OPER position. Close the transmitter and receiver doors.

Table I. Test Procedure (Receiver Baseband Gain)
(Transmitter Baseband Gain), (Receiver Fault Sensing)

Channel Loading	Test Tone Rcvr. Output	Continuity Pilot		Test Tone (3) Underdeviation (ref: 200 kHz)	Rcvr.Baseband Gain (1) HP400EL Indication Using GE Test Set	Transmitter Baseband Gain Meter Indication
		Frequency	(Rcvr. Fault Sensing) Level			
≤300	-20 dBm	3.2 MHz	19.4 mV	0 dB	760 mV	154 mV
	-15	3.2	34.5	0	677 (2)	274
480	-20 dBm	3.2 MHz	19.4	0 dB	760 mV	154 mV
	-15	3.2	34.5	0	677 (2)	274
600	-20 dBm	3.2 MHz	19.4 mV	-2.5 dB	507 mV (2)	154 mV

NOTES:
1. If a "rms responding" meter such as a HP-3400A is used, increase levels 0.9 dB.
2. Set GE Test Set switch to 70-75 MHz for these levels.
3. Underdeviation is required for conformance with FCC regulations on necessary bandwidth.

(13) In the controller shelf, place the manual selector switches on the transmitter memory and receiver baseband logic units in their A OPERATE (upper) position.

(14) Repeat steps 2 through 12 for the B transmitter.

(15) In the controller shelf, place the transmitter memory unit selector switch in its AUTOMATIC (center) position.

(16) Place the receiver baseband logic unit selector switch in its AUTOMATIC (center) position.

TRANSMITTER AFC

(1) Assure that the transmitter undergoing test is not the transmitter remaining in service (in a Standby rack).

(2) Open the transmitter door and on the AFC control panel, set the AFC ON-AFC SET switch to AFC SET.

(3) Set the OPERATE/TEST switch on the transmitter rf oscillator chassis to its TEST position.

(4) Set the METER SELECTOR switch on transmitter door to VAR V. Observe the rack meter and, if necessary, adjust R2 (VAR VOLT) for the meter indication stamped on the transmit rf oscillator chassis.

(5) Connect frequency counter to jack J6 on crystal AFC unit. If necessary, set rf oscillator mechanical frequency adjust for a transmitter frequency within ±500 kHz of the assigned frequency marked on the transmitter nameplate.

(6) Set the AFC ON-AFC SET switch to AFC ON. Measure transmitter frequency.

(7) Connect test equipment as shown in Figure 5.

(8) The rf voltmeter should read 0 ±2 dBm.

(9) Disconnect test equipment from the configuration shown in Figure 5, and connect it as shown in Figure 6.

(10) Observe VOM indication; it should be greater than 0.5 mA.

(11) Diode current is adjusted by use of the 360 MHz FILTER ADJ screws. Each screw is adjusted for peak diode current. Screws should be run close together, with a relative length between screws being 1/4 inch.

(12) Connect a 50-ohm terminated rf voltmeter to 70 MHz TEST jack J3.

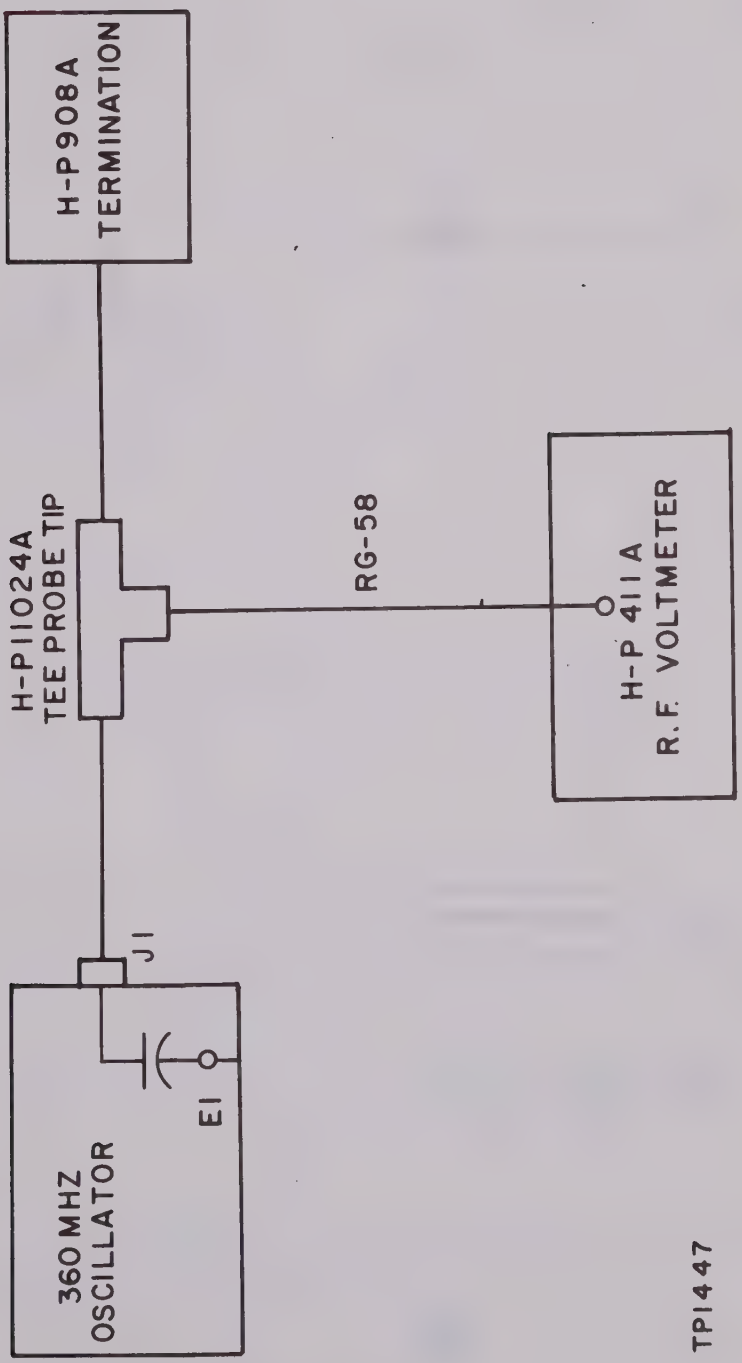


Figure 5. Transmitter Frequency Adjustment Test Setup Diagram

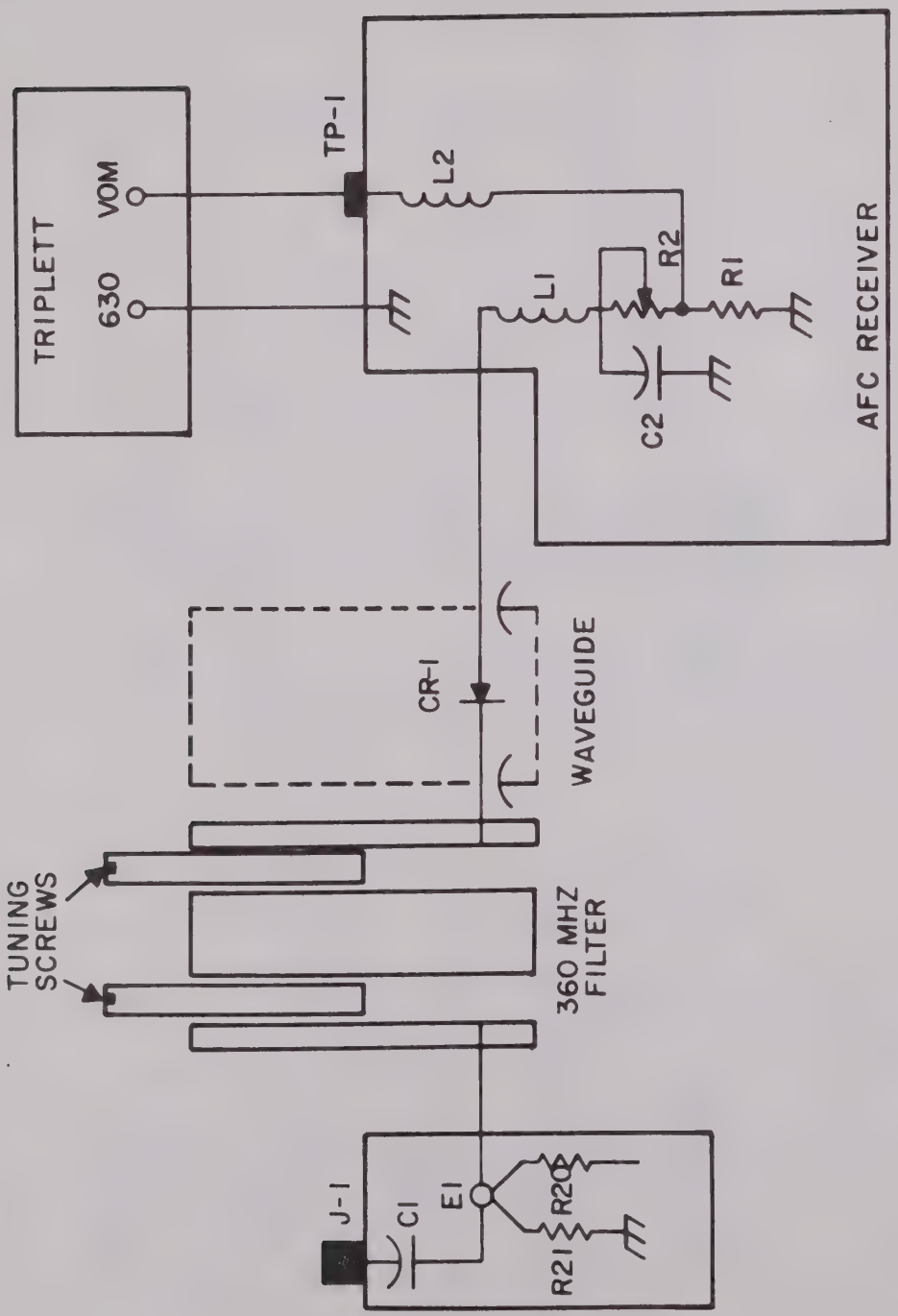


Figure 6. Diode Current Adjustment Test Setup Diagram

(13) Operate pushbutton S1 on the 70 MHz oscillator. The rf voltmeter reading should be 33 mV ±1 mV rms. 70 MHz IF level is adjusted using the rf attenuator in the AFC assembly.

(14) Operate pushbutton S2 on the 70 MHz oscillator. The rf voltmeter reading should be 33 mV ±1 mV rms. 70 MHz oscillator can be adjusted with potentiometer R16.

(15) Connect test equipment as shown in Figure 7.

(16) Set deviation calibrator as follows:

a. Deviation switch to DEVIATION position.

b. Frequency selector switch to 65 MHz-75 MHz position.

(17) Set oscilloscope as follows:

a. Horizontal sensitivity to Internal Sweep.

b. Horizontal sweep time to 0.5 ms/cm.

(18) The receiver sensitivity must be 35 mV/MHz. The square-wave output measured on the oscilloscope must be 350 mV p-p.

(19) Record operating frequency of the transmitter being serviced. Be sure it is operating within the tolerance of 0.002% of assigned frequency. If not, replace crystal AFC unit using the procedure given in the CRYSTAL CONTROLLED AFC section of LBI-16055.

NOTE

Steps 20 through 29 need to be done only if the transmitter AFC amplifier board has been replaced.

(20) Set the transmitter METER SELECTOR switch to AFC. The rack meter should read zero on the lower scale.

(21) Set the AFC ON-AFC SET switch on the transmitter door to its AFC SET position.

(22) Depress and tape the waveguide plunger down.

(23) Observe the frequency counter and adjust the rf oscillator tuning screw to obtain a frequency 10 MHz below that recorded in Step 19.

NOTE

In the event the AFC circuit does not pull back within the limit specified, adjust AFC gain control R3 on AFC amplifier as necessary.

(24) Set the AFC ON-AFC SET switch on the transmitter door to its AFC ON position. The frequency counter should read within 20 ±5 kHz of the frequency recorded in Step 19.

(25) Set the AFC ON-AFC SET switch on the transmitter door to its AFC SET position. Observe the frequency counter and adjust the rf oscillator tuning screw to obtain a frequency 10 MHz above that recorded in Step 19.

(26) Set the AFC ON-AFC SET switch on the transmitter door to its AFC ON position. The frequency counter should read within 20 ±5 kHz of the frequency recorded in Step 19.

(27) Set the AFC ON-AFC SET switch on the transmitter door to its AFC SET position. Observe the frequency counter and use the rf oscillator tuning screw to tune the oscillator to the assigned frequency recorded in Step 19.

(28) Set the AFC ON-AFC SET switch on the transmitter door to its AFC ON position. The rack meter should indicate center zero on its lower scale and the frequency counter should read within 0.002% of the assigned frequency.

(29) Disconnect frequency counter and return rack to normal operating status.

TRANSMITTER LINEARITY (Single Rack)

Perform this procedure only after the rf oscillator has been replaced or when transmitter linearity checks dictate. Prior to performing this procedure, refer to the TRANSMITTER FREQUENCY section.

NOTE

If a distortion test set is not available, refer to the rf oscillator tuning procedure in the IN-RACK TUNING PROCEDURES section of LBI-16054.

NOTE

Receiver linearity adjustments must be completed just prior to checking transmitter linearity. Refer to receiver procedures given in Chapter 5 Section II.

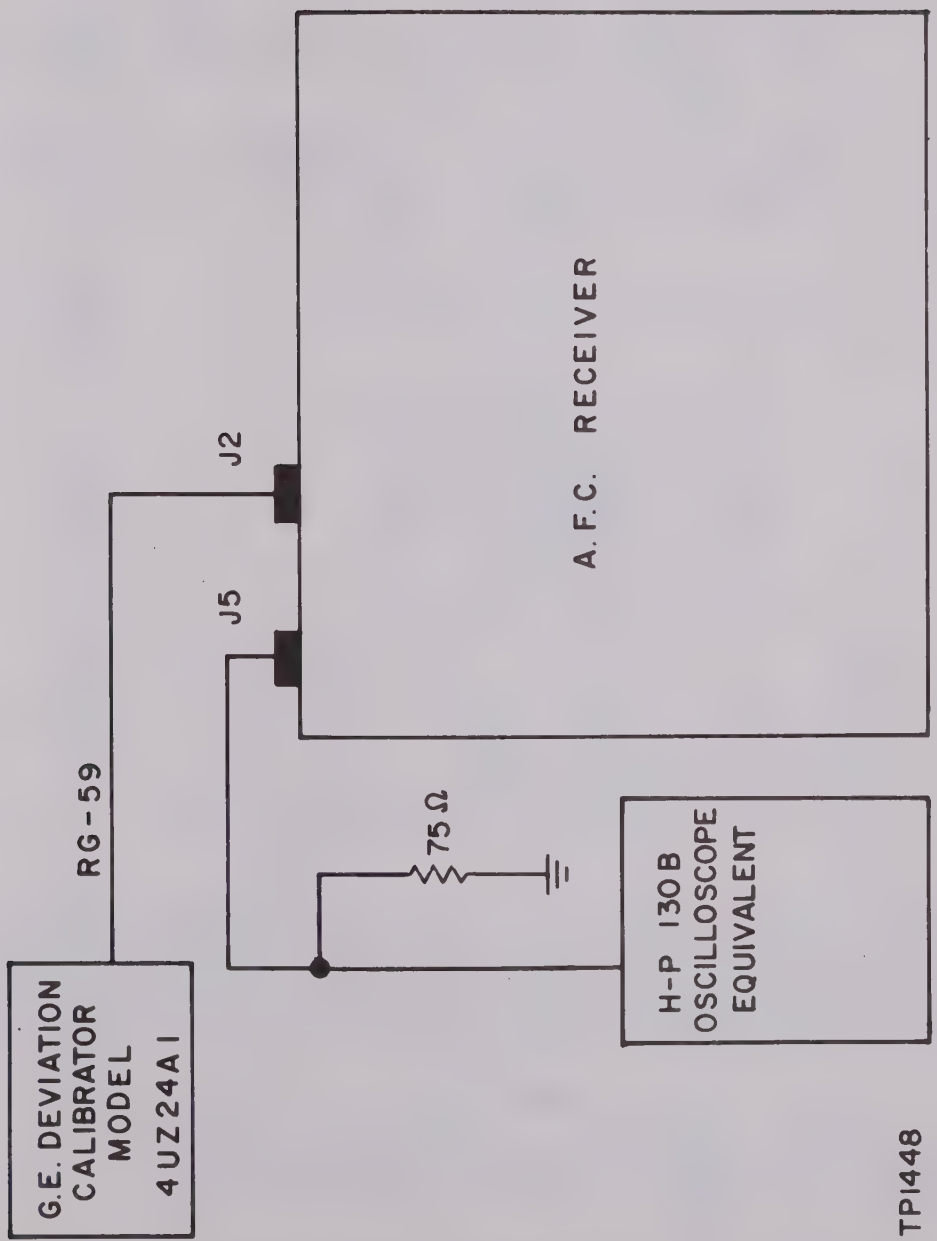


Figure 7. Transmitter AFC Test Setup

(1) Connect test equipment as shown in Figure 8.

(2) Set the AFC ON-AFC SET switch on the transmitter door to its AFC SET position.

(3) Set the fade simulator on the receiver used in the test setup to maximum attenuation (cw).

(4) Depress and tape down the waveguide plunger on the transmitter being serviced.

(5) Set the OPERATE/TEST switch on the transmitter rf oscillator chassis to its TEST position.

(6) Connect oscilloscope to TP1 on transmitter AFC unit and observe frequency of crystal AFC crossover by tuning rf oscillator mechanical adjust screw.

CRYSTAL AFC CENTER FREQUENCY

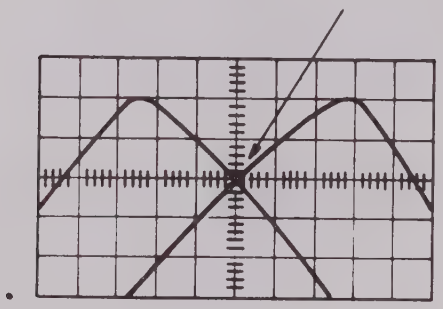


Figure 9. Frequency Crossover Display at TP1

(7) Set the LINEARITY/DELAY switch on the distortion test set to its LINEARITY 1% position.

(8) Adjust oscilloscope linearity presentation for a display of 1% per centimeter.

(9) Check linearity sweep width as follows: Insert frequency markers from GE Test Set by removing the plug covering C29 on receiver IF input amplifier and inserting output cable from GE Test Set into this area. Set FUNCTION switch to 65-75 MHz position and MARKERS/DEVIATION switch to MARKERS.

NOTE

Adjust the sweep voltage on distortion test set to position markers to display a sweep width of ±10 MHz.

(10) Overlay this presentation on receiver linearity presentation previously traced over oscilloscope display. The difference in the overlays represents transmitter linearity.

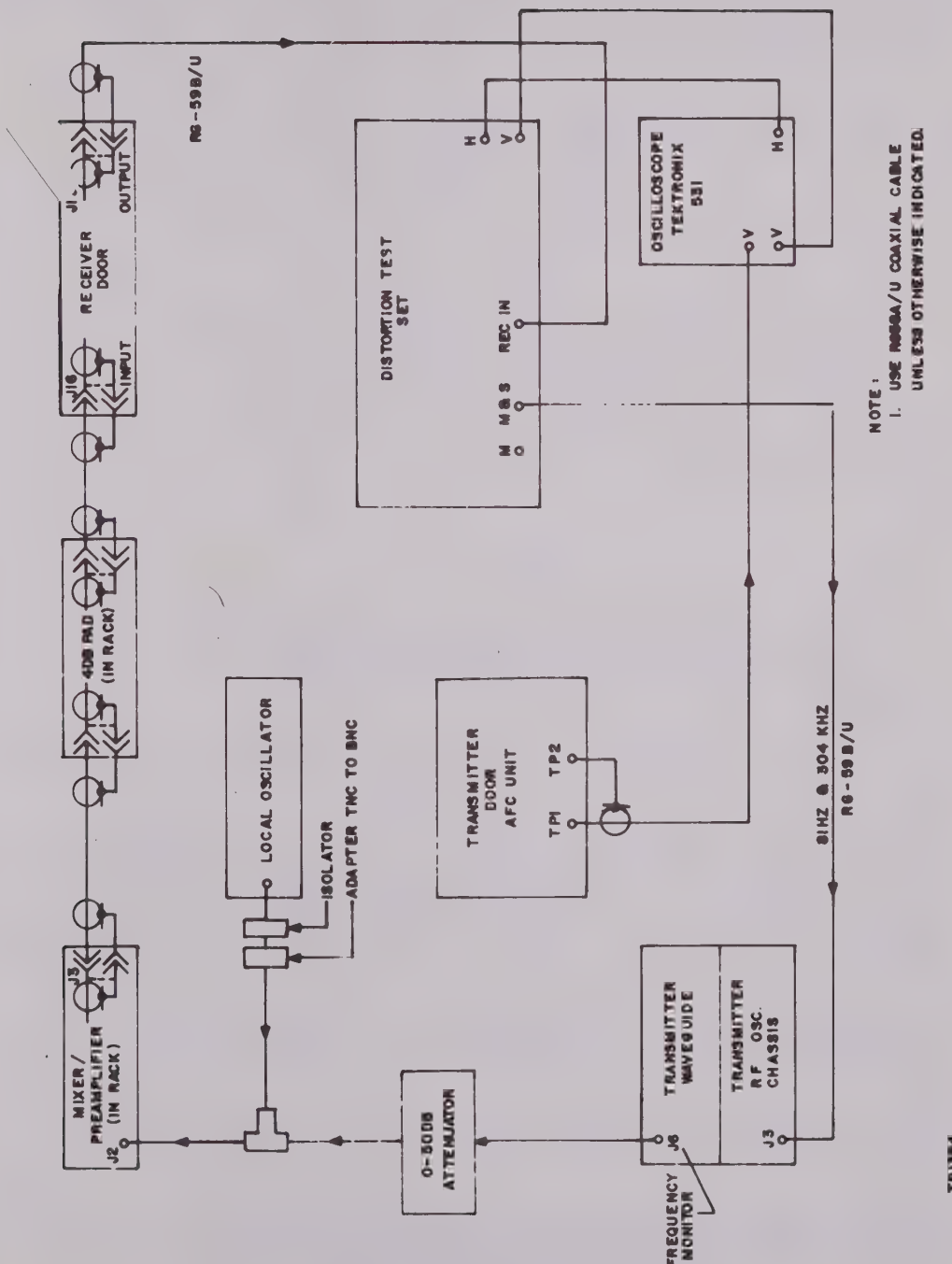


Figure 8. Transmitter Linearity Adjustment, Test Setup Diagram

(11) When transmitter linearity is 2% or greater over ±8 MHz, correct it by tuning the modulator of the rf oscillator while maintaining the assigned frequency and specified output power.

(12) Adjust the modulator in small increments while observing linearity and frequency on the oscilloscope display. No appreciable loss of power should occur.

(13) Linearity should be within the following tolerances:

±6 MHz - 0.2%
±8 MHz - 0.4%

NOTE

It is necessary to check Transmitter Baseband Gain and Transmit Frequency each time transmitter linearity is adjusted.

(14) Disconnect test equipment and return rack to normal operating status.

FAULT SENSING

NOTE

It is assumed that pilot tone oscillator signal level has not been changed and that the level is 3 dB below test tone (1.55 mV).

(1) Set the OPERATE/TEST switch on the transmitter rf oscillator chassis to its OPERATE position.

(2) Using a high impedance frequency selective voltmeter, measure the level of pilot tone at jack J3 on the RF oscillator. This should be as specified above. Refer to controller procedures given in Chapter 5 Section III for pilot tone adjustment.

(3) Adjust the gain potentiometer on the transmitter sensing unit until the FAULT light on the transmitter door just comes on.

(4) Set the METER SELECTOR switch on the transmitter door to PILOT.

(5) Adjust the pilot meter control on the transmitter sensing unit to obtain a rack meter reading of 0.55.

(6) Adjust pilot level to red line on the rack meter using the pilot receiver gain control; the FAULT light should go out.

(7) Set the METER SELECTOR switch on the transmitter door to POWER.

(8) Adjust POWER MONITOR control on the transmitter door to obtain a rack meter reading of 50% of red line.

(9) Adjust power monitor control on the transmitter sensing unit until the FAULT light on the transmitter door just
(10) comes on.

(10) Adjust the POWER MONITOR control on the transmitter door for a red line reading on the rack meter. The FAULT light should go out.

(11) Return the rack to its normal operating status.

TELECOMMUNICATION PRODUCT DEPARTMENT
GENERAL ELECTRIC COMPANY
LYNCHBURG, VIRGINIA

Printed in U.S.A.

TRS-696B TRANSMITTER MAINTENANCE TROUBLESHOOTING AND FIELD TUNING

GENERAL

Troubleshooting and field tuning procedures consist of (1) troubleshooting techniques for the transmitter, (2) troubleshooting techniques for rf units, and (3) in-rack tuning procedures.

TEST EQUIPMENT

The procedures defined above are arranged so the need for auxiliary test equipment is minimized. A list of those pieces of test equipment and accessories that are required with suggestions as to kind follows.

Frequency Counter with Converters:	HP5246L (Counter), and HP5254, HP5255A (Converters).
OR	
Wavemeters:	HP536A, PHG532A, HPJ532A
Power Meter:	HP432A
Voltmeter (rms):	HP400EL
Test Oscillator:	HP200CD
Thermistor Mount:	HP478A
Detector:	HP432A with options 002 and 003
30 dB, 20-watt Attenuator:	NARDA 766-30
Type "OSM" (3mm)-to-Type "N" Adaptor:	OMNI SPECTRA Model 21030

PRECAUTIONARY MEASURES

That solid state rf devices can be easily damaged by improper handling is emphasized. Particular caution should be exercised when performing the following operations.

1. Dc Connection - Turn the power supply OFF before connecting or disconnecting dc power connectors on transmitter units, doors and assemblies.

2. RF Connection - Turn the power supply OFF before connecting or disconnecting rf coaxial connectors to transmitter rf units.

3. RF Amplifier

A. The rf amplifier should NEVER be operated with its output unterminated (output isolator removed).

B. The rf amplifier should NEVER have rf power applied to its input in the absence of dc power (+26 volts).

4. RF Oscillator

A. The rf oscillator should NEVER be operated with its output unterminated (output isolator removed).

B. If, during frequency tuning or linearization, the rf oscillator loses its power (stops oscillating), turn the power supply off immediately. The rf oscillator will not restart itself; the power supply must first be turned off, then on again before the rf oscillator will restart.

TROUBLESHOOTING TECHNIQUES FOR THE TRANSMITTER

Troubleshooting techniques for the transmitter are given in block diagram form. The block diagram shown in Figure 1 will serve as a guide for troubleshooting when there has been a loss of modulation. When there is either no power or low power at the rack antenna port, the block diagram shown in Figure 2 can be used as a troubleshooting guide.

TROUBLESHOOTING TECHNIQUES FOR RF UNITS

Troubleshooting techniques for rf units is comprised of four procedures: (1) rf cables, (2) transmitter rf oscillator chassis, (3) rf amplifier, and (4) rf multiplier. These procedures will help the technician determine if a failure in one of the transmitter rf components has occurred.

RF CABLES

Inspect all rf cables for broken joints and misalignment.

NOTE

The section of cable that goes from the multiplier to the rf launcher must always remain with the launching section because it and the launching section were matched as an assembly.

NOTE

If a multiplier proves to be defective, it is recommended that it be returned to the factory for repair and retuning. Service can be maintained with a spare multiplier that is field tuned as per the in-rack multiplier tuning procedure. When the original multiplier has been returned, it should be re-installed in its initial position to insure maximum performance.

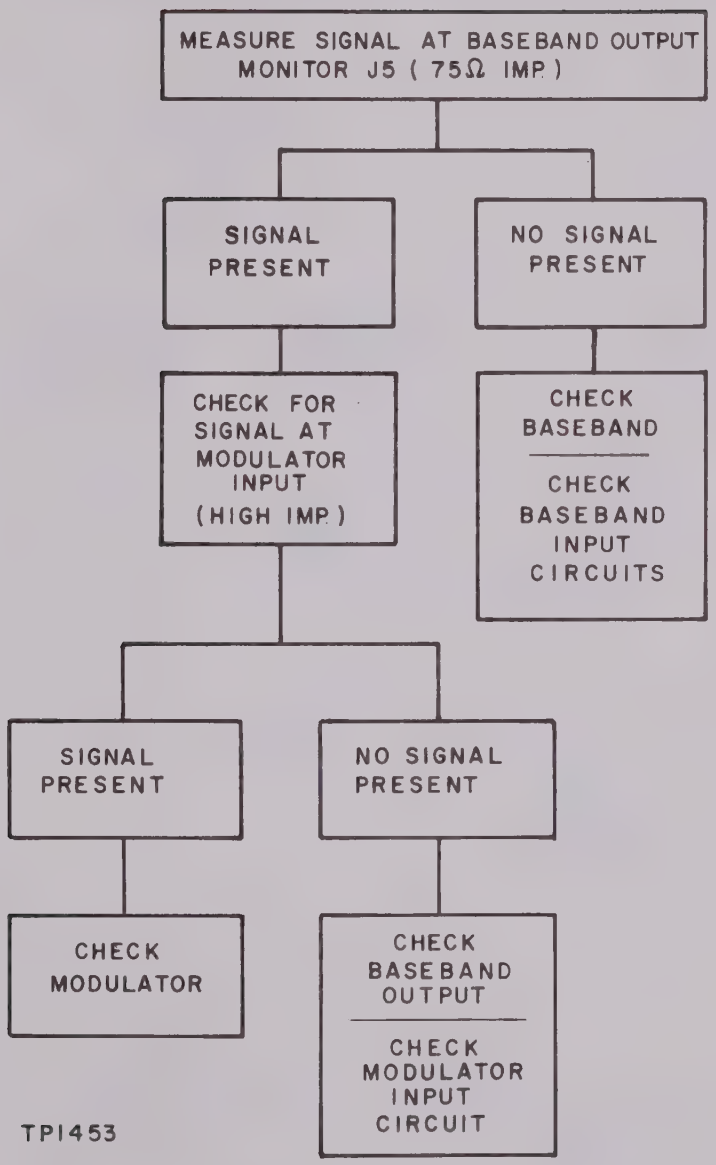


Figure 1. Block Diagram Troubleshooting Guide for Loss of Transmitter Modulation.

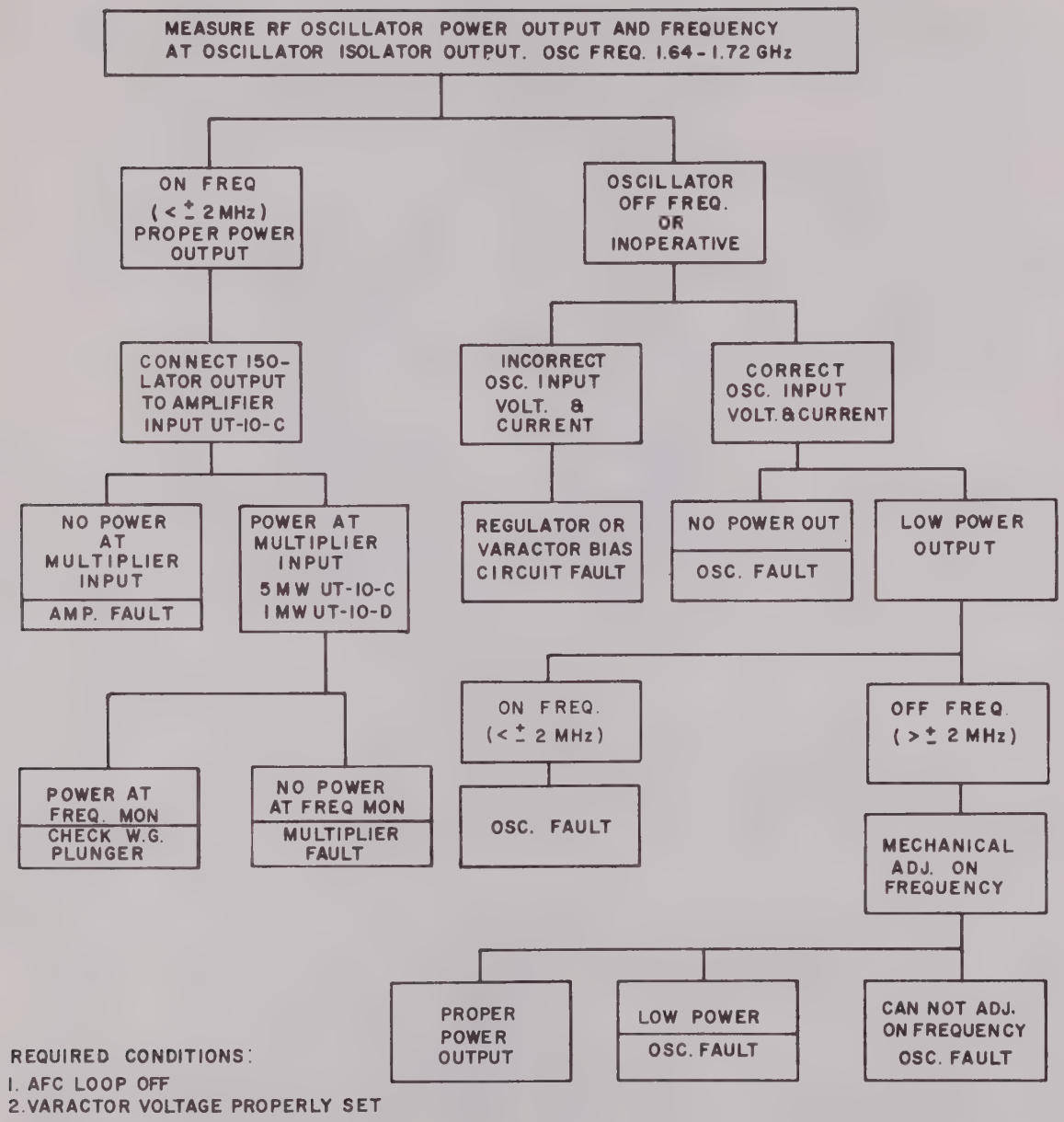

MEASURE RF OSCILLATOR POWER OUTPUT AND FREQUENCY AT OSCILLATOR ISOLATOR OUTPUT. OSC FREQ. 1.64 - 1.72 GHz
ON FREQ (< ± 2 MHz) PROPER POWER OUTPUT
OSCILLATOR OFF FREQ. OR INOPERATIVE
CONNECT ISOLATOR OUTPUT TO AMPLIFIER INPUT UT-10-C
INCORRECT OSC. INPUT VOLT. & CURRENT
CORRECT OSC. INPUT VOLT. & CURRENT
NO POWER AT MULTIPLIER INPUT
AMP. FAULT
POWER AT MULTIPLIER INPUT 5 MW UT-10-C 1 MW UT-10-D
REGULATOR OR VARACTOR BIAS CIRCUIT FAULT
NO POWER OUT
OSC. FAULT
LOW POWER OUTPUT
ON FREQ. (< ± 2 MHz)
OFF FREQ. (> ± 2 MHz)
POWER AT FREQ. MON
CHECK W.G. PLUNGER
NO POWER AT FREQ MON
MULTIPLIER FAULT
OSC. FAULT
MECHANICAL ADJ. ON FREQUENCY
PROPER POWER OUTPUT
LOW POWER
OSC. FAULT
CAN NOT ADJ. ON FREQUENCY
OSC. FAULT
REQUIRED CONDITIONS:
1. AFC LOOP OFF
2. VARACTOR VOLTAGE PROPERLY SET

Figure 2. Block Diagram Troubleshooting Guide for No or Low Power at Rack Antenna Port.

TRANSMIT RF OSCILLATOR CHASSIS

1. Open the transmitter door and on the AFC control panel, set the AFC ON-AFC SET switch to AFC SET.

2. Set the OPERATE/TEST switch on the transmitter RF oscillator chassis to its TEST position.

3. Set the meter selector switch on transmitter door to VAR V. Observe the rack meter and, if necessary, adjust R2 (VAR VOLT) for the meter indication stamped on the transmitter RF oscillator chassis.

4. Set the meter selector switch on the transmitter door to OSC V. The meter indication should be 0.8 red line ±2 major divisions. If the meter indication is low, check the dc voltage at J1 on the -32 volt regulator printed board. The voltage at J1 should be -32 volts ±1 volt. If the voltage at J1 is not within the specified tolerance, check rack power supply and interconnection wiring.

5. Set the meter selector switch on the transmitter door to OSC CUR. This indication should be red line +0, -1 major division.

6. Connect frequency counter to jack J6 on crystal AFC unit. If necessary, set RF oscillator mechanical frequency. Adjust for a transmitter frequency within ±500 kHz of the assigned frequency marked on the transmitter nameplate.

7. Measure the output power at J1 on the oscillator output isolator. The power level should be within the range given in Table I of "Maintenance, Transmitter RF Oscillator".

NOTE

If the above requirements cannot be met, it can be assumed that the RF oscillator chassis is defective and the entire RF oscillator chassis (including output isolator) should be returned for repair.

NOTE

The transmitter baseband amplifier can be field repaired or changed out. However, after repairing or changing the baseband amplifier, transmitter deviation and frequency response must be checked.

TRANSMITTER BASEBAND AMPLIFIER

1. Check for the presence of power supply voltage at J1 on the transmitter baseband amplifier printed board.

2. Position the OPERATE/TEST switch on the transmitter RF oscillator chassis to TEST.

3. Apply a 1 MHz 5 mV signal to J3 on the transmitter RF oscillator chassis.

4. Measure the signal at output monitor (J5) on the transmitter RF oscillator chassis into a 75-ohm termination. The voltage at J5 should be 60 mV +50, -30 mV.

5. Measure the signal at J6 on the transmitter baseband amplifier printed circuit board using a high impedance bridging technique. The signal voltage at J6 should be approximately three times larger than the value observed in Step 4.

RF POWER AMPLIFIER (UT-10-C Only)

1. Set the meter selector switch on the transmitter door to AMPL V. The meter indication should be red line ±5 small divisions. If not within this tolerance, check the voltages from power supply and interconnection wiring up to dc input (J3) on amplifier (this voltage should be 26 ±1 Vdc.)

2. Set the meter selector switch on the transmitter door to AMPL CUR. The meter indication should be 0.8 red line ±2 major divisions. (Note: the amplifier will not draw current in the absence of drive signal from the RF oscillator.)

3. Measure oscillator power output at J1 on the RF oscillator chassis. The power level should be within the range given in Table I of "Maintenance, Transmitter RF Oscillator" (LBI-16050). If the power at J1 is not within the specified range, check the transmitter RF oscillator.

4. Connect a power bridge to the multiplier input monitor (J2). The power measured at this point should be from 5 to 8 mW.

NOTE

If the dc and RF inputs to the amplifier meet the requirements of Steps 1, 2 and 3, but the amplifier fails to meet the requirements of Step 4, it can be assumed the amplifier is faulty and the entire amplifier (including the amplifier output circulator and RF coaxial interconnecting cable) should be returned for repair.

RF MULTIPLIER

1. Connect a power bridge to the RF multiplier input monitor (J2). The power measured at J2 should be as follows:

UT-10-C	5 to 8 mW
UT-10-D	1 to 2 mW

2. Measure the power and frequency at the AFC frequency monitor (J6). The power measured at J6 should not be less than 8 mW with the transmitter frequency set to within ±5 MHz of the assigned frequency, for both the UT-10-C and UT-10-D transmitters.

IN-RACK TUNING PROCEDURES

In-rack tuning procedures consist of a procedure for the transmitter RF oscillator and a procedure for the RF multiplier. These procedures are designed to permit in-rack tuning of an RF oscillator or multiplier for temporary operation (as, for example, the field tuning of a spare unit for use until a factory- or bench-tuned unit is available). It is important to note that the performance of units tuned using these procedures may be degraded, causing an increase in intermodulation noise (up to 50 pwp or 73 dB signal-to-distortion ratio for a single hop with 420 channel loading).

TRANSMITTER RF OSCILLATOR

The following procedure for tuning the transmitter RF oscillator is intended for use when a distortion test set is not available. It is to be used only as a temporary measure such as field tuning of a spare until a factory- or bench-tuned unit is available. The following degradation in performance (signal-to-distortion ratio for 420 channel loading) can be expected as compared to a factory-tuned unit.

Delivered performance for a factory-tuned unit:	80 dB*
Typical performance for this tuning procedure:	73 dB*

*Probable worst case in 70 kHz slot

CAUTION

Turn the power supply OFF when making any circuit changes to avoid damage to the RF oscillator or power amplifier.

If the replacement oscillator is within ±10 MHz of the assigned frequency, it is likely that satisfactory performance will result from simply changing its frequency by mechanical tuning. However this is not always the case; therefore, after tuning to the new frequency, the measurements in Steps 8 through 19 should be made. If the results are not as specified, the entire procedure given here should be followed.

NOTE

Replace a UT-10-D transmitter RF oscillator chassis with a UT-10-D unit only. A UT-10-C RF oscillator may be replaced with either a UT-10-C or a UT-10-D unit.

1. Remove the transmitter RF oscillator chassis from the rack and remove the modulator from the chassis by loosening the adjustable sleeve lock nut and unscrewing the modulator from the oscillator.

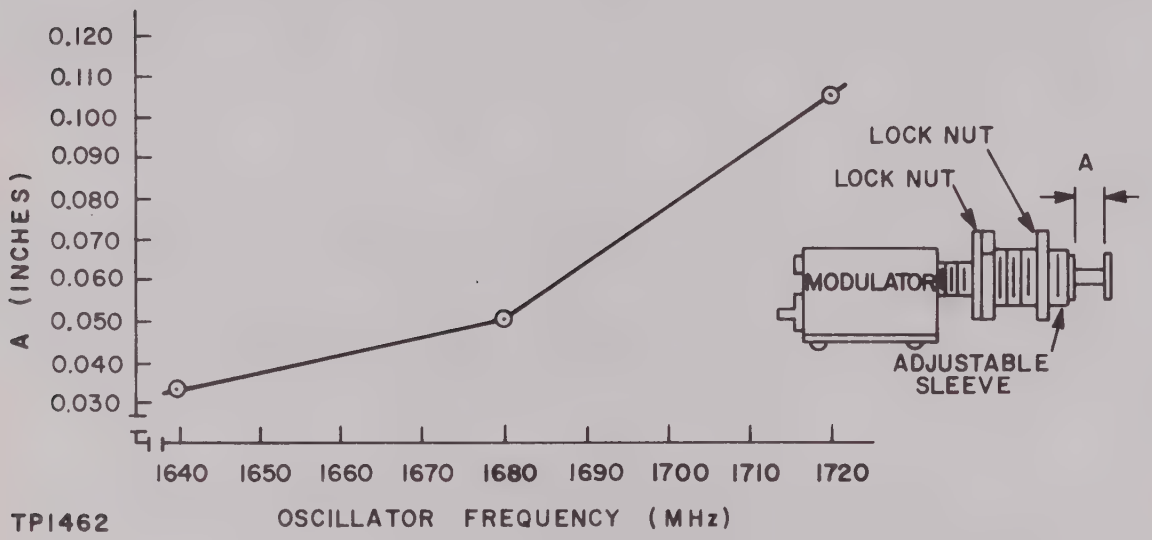


Figure 3. Modulator Adjustment

2. Refer to Figure 3. Select the "A" dimension corresponding to the desired frequency from the graph. Loosen the lock nut, turn the adjustable sleeve to obtain the selected "A" dimension and tighten the lock nut.

3. Screw the modulator into the oscillator so the modulator probe is approximately flush with the inside wall of the oscillator cavity as indicated in Figure 4. Add the 4-inch piece of wire and install the clip-in capacitor shown in Figure 4.

4. Place the RF oscillator chassis in the rack with J1 plugged in and measure the oscillator output frequency (in the range from 1640 MHz to 1720 MHz). The normal power output at this point is from 1 to 1.6 watts.

5. Use the mechanical frequency adjust screw to obtain the desired frequency.

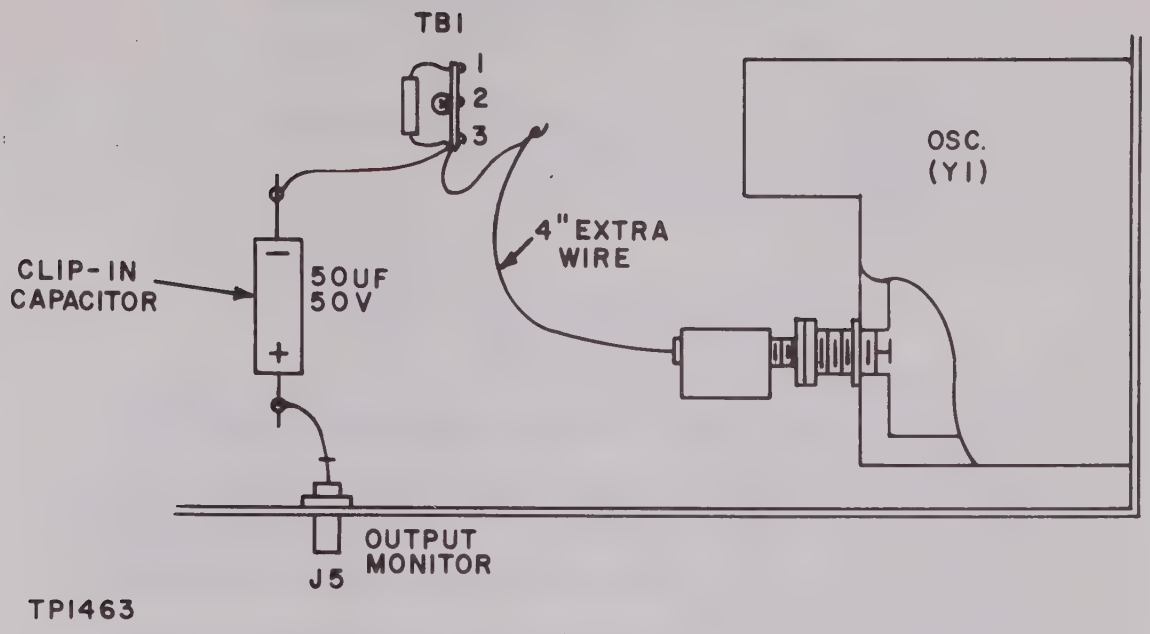


Figure 4. Replacement of Modulator

6. Refer to Figure 5. Select the oscillator current corresponding to the required power output from the graph. If the required power output is not known, it can be determined from Figure 6. Set the rack meter up to monitor oscillator current and adjust R13 on the regulator board to obtain the selected meter reading, while taking care to maintain the desired frequency.

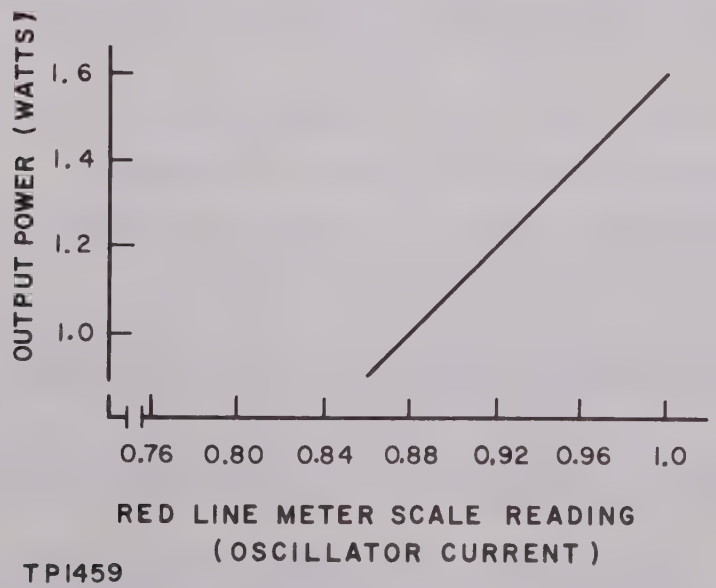


Figure 5. Oscillator Current/Output Power Data

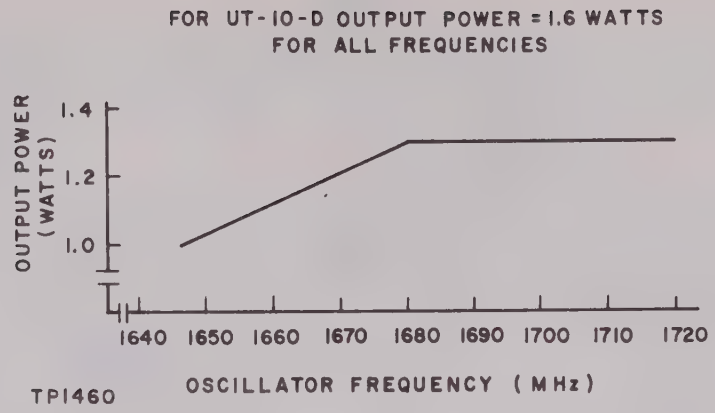


Figure 6. Oscillator Frequency Output Power Data

7. Depress the waveguide plunger and tape it down. Complete the installation of the oscillator chassis in the rack.

8. Set the AFC ON-AFC SET switch on the transmitter door to its AFC SET position.

9. Switch the rack meter selector to the transmitter under test. Switch the transmitter meter selector to AFC.

10. Using the rack meter for a frequency indication, tune the transmitter to the desired frequency with the transmitter RF oscillator FREQ ADJ control. (Adjust for zero on the lower scale---should be able to obtain both up-scale and down-scale readings.)

11. Disconnect the 70 MHz reference oscillator from the AFC unit by removing the cable from J2 on the AFC unit. Connect the General Electric Test Set to J2.

12. Adjust the test set as follows:

    a. MARKER-DEVIATION switch to DEVIATION

    b. Frequency selector switch to 65-75 MHz

    c. 10 dB attenuator switch to OUT

13. High impedance bridge a VTVM to the AFC unit ERROR OUTPUT (J5) maintaining the existing AFC connections.

14. Depress S2 on the 70 MHz reference oscillator chassis and record the indication on the VTVM. Reconnect the 70 MHz reference oscillator to J2 on the AFC unit.

15. Apply a 10 MHz sine wave signal to the OUTPUT MONITOR port (J5) on the RF oscillator chassis, setting the input level, using a bridged rms VTVM as follows:

a. HP400EL VTVM (avg. m.) 1.7 volts

b. HP3400 VTVM (rms m.) 1.5 volts

16. Depress S1 on the 70 MHz reference oscillator and observe the indication on the VTVM while slowly increasing the penetration of the modulator probe. Continue increasing the penetration of the modulator probe until the VTVM reading with S1 depressed is within 10% of the value recorded in Step 14.

NOTE

It is necessary to monitor power output and transmitter frequency during this operation. While the rack meter AFC indication could be used to monitor frequency, it could indicate false or spurious nulls if the transmitter is allowed to drift more than 20 MHz from its assigned frequency. Therefore, a wavemeter or counter should be connected to AFC frequency monitor jack J6. Remove modulation before measuring frequency.

17. The final measurement should be made when the transmitter is within 1 MHz of its assigned frequency (AFC rack meter indication 0 ±4 major divisions as read on the lower scale) and the power is within 50 mW of the value shown in Figure 6. Output power should be changed (if necessary) by adjusting R13 on the regulator board.

18. Disconnect the VTVM from J5 on the AFC unit. Remove the clip-in capacitor and 4-inch piece of wire installed at Step 3, and reconnect the modulator to J6 on the baseband amplifier board. Baseband gain should now be set for the correct transmitter deviation. Refer to Chapter 5, LBI-16048.

19. Release the waveguide plunger.

RF MULTIPLIER

The following procedure for tuning the RF multiplier is designed to minimize the need for auxiliary test equipment, and is to be used only as a temporary measure such as field tuning of a spare until a factory- or bench-tuned unit is available. The performance of a unit tuned using this procedure may be degraded, causing an increase in intermodulation noise (up to 50 pwp or 73 dB signal-to-distortion ratio for a single hop with 420 channel loading).

1. Turn the power supply OFF and install the multiplier to be tuned.

2. Depress the waveguide plunger and tape it down. This is necessary in order to maintain a good VSWR.

3. Turn the power supply ON and connect a power bridge to the AFC frequency monitor test point, J6.

4. Refer to Figure 7. With the transmitter unmodulated and AFC on, adjust output filter resonator tuning screws 3 and 5, input resonator tuning and output filter coupling screw 4 in sequence for maximum power.

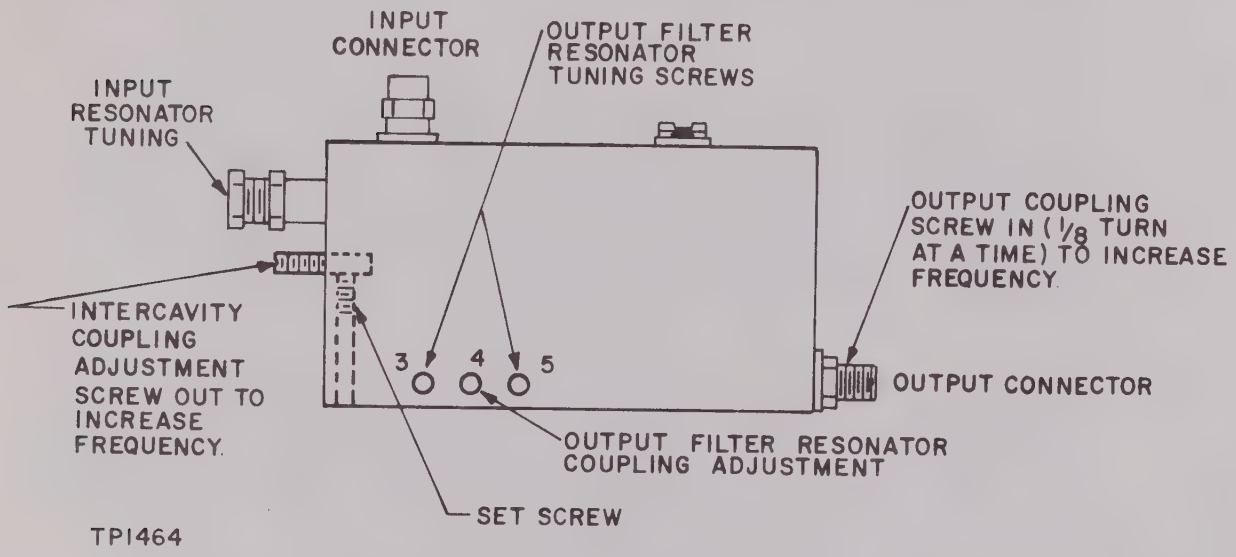


Figure 7. Multiplier Tuning Control Layout

5. Disconnect the power bridge from J6, connect a counter to J6 and check transmitter frequency. Turn the AFC off, and, using the mechanical adjustment, tune the oscillator to within 100 kHz of the assigned transmitter frequency.

6. Connect the oscilloscope, detector and test oscillator into the test setup shown in Figure 8.

7. Remove the wires from P5 and P6 on the transmitter baseband amplifier. Insert a 50 µf 25 volt capacitor between P5 and P6, with the capacitor negative terminal toward the modulator.

8. Apply 7 Vrms at 60 cycles to the baseband MONITOR OUTPUT test point. Adjust oscilloscope sensitivity so 10 scale divisions will represent transmitter peak power.

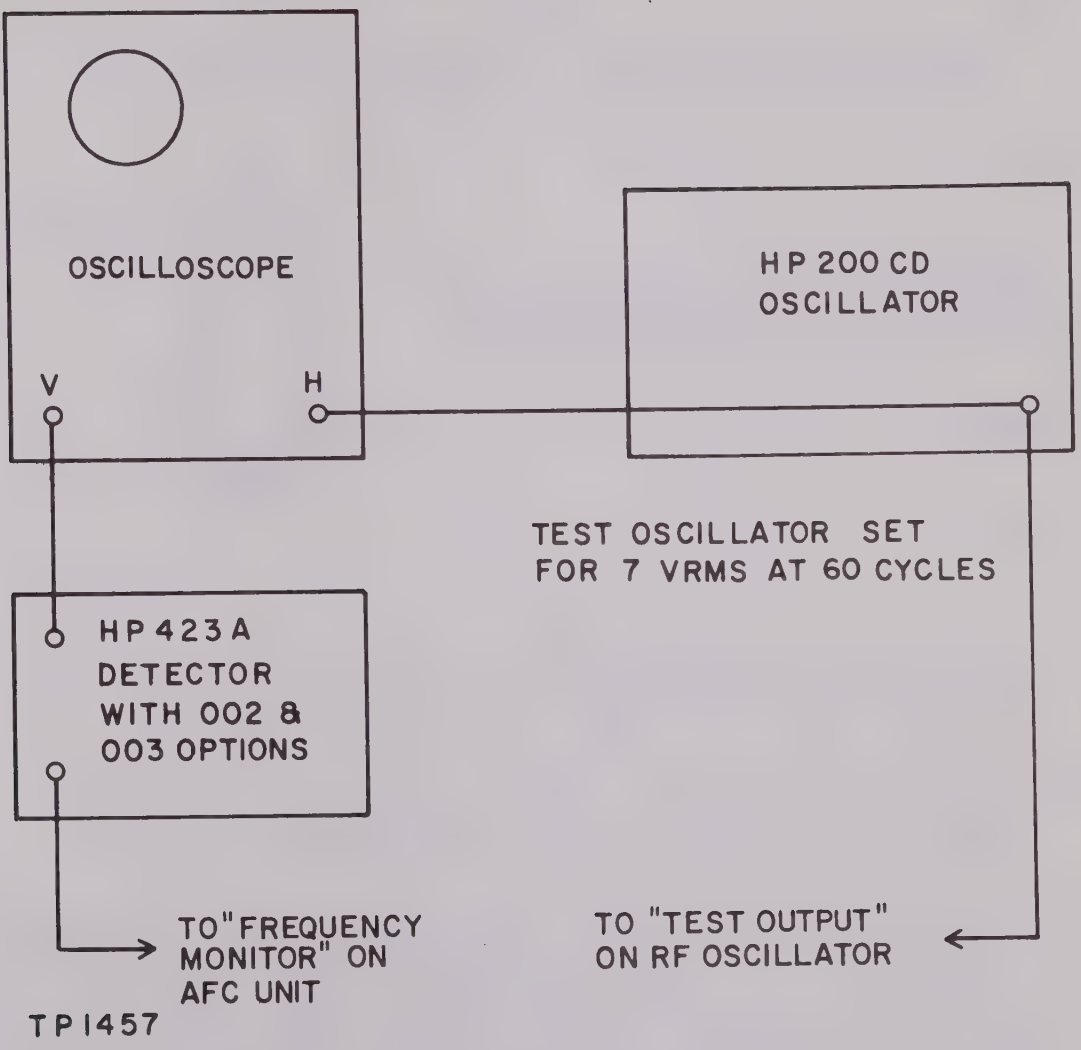


Figure 8. Test Setup

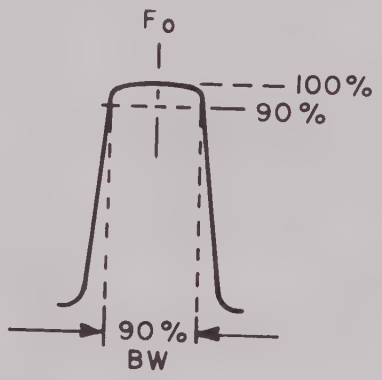
9. Adjust output filter resonator tuning screws 3 and 5, input resonator tuning, and output filter coupling screw 4 (see Figure 7) for a maximum power output of +29 dBm for standby or +30 dBm for basic UT-10-C transmitters, or +23 dBm for standby or +24 dBm for basic UT-10-D transmitters, while maintaining the amplitude response shown below.

NOTE

Remove modulation before measuring transmitter power.

PEAK-TO-PEAK AMPLITUDE VARIATIONS MUST NOT EXCEED 5% (0.5 DIVISIONS) FOR Fo ± 15MHz (66% OF 90%)

TP1465



NOTE

The 90% amplitude bandwidth will be approximately 40 MHz, and is determined by the three-cell filter located between the multiplier and AFC unit.

10. If the above power and amplitude response requirements are met simultaneously without discontinuities in the amplitude response, proceed to step 13.

11. In most cases it is neither necessary or advisable to change the intercavity or output coupling adjustments in the field (see Figure 7); however, both may be field-tuned if necessary. The intercavity coupling adjustment affects multiplier stability and is used to minimize breakup (discontinuities). The output coupling adjustment affects amplitude response, and is used to increase or decrease the coupling of the output circuit. See illustration.

TP1466

undercoupled output coupling screw in

over coupled output coupling screw out

12. Adjust the intercavity coupling, or the output coupling and repeat step 9. Continue this process until the requirements of step 9 are met.

13. Disconnect the test equipment, connect P5 to J5 and P6 to J6 on the baseband output, and release the waveguide attenuator plunger.

TELECOMMUNICATION PRODUCTS DEPARTMENT
GENERAL ELECTRIC COMPANY
LYNCHBURG, VIRGINIA

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TRS-696B TRANSMITTER MAINTENANCE REMOVAL AND REPLACEMENT PROCEDURES

GENERAL

Removal and replacement procedures are provided for a transmitter door, and for the various subassemblies and circuit cards located on the transmitter door and shelf. The procedures contain a reference to checkout procedures needed to return a transmitter to service after the installation of a repaired or replacement card or subassembly.

Service will be interrupted when removal and replacement procedures are used on the transmitter in a Basic Rack. However, these procedures can be used on a transmitter in a Standby or Diversity Rack without interrupting service by taking the appropriate step outlined below.

Standby Rack---Set the MANUAL SELECTOR switch on the transmitter memory unit (on the controller shelf) to its A operate (upper) position when transmitter B is to be worked on, or to its B operate (lower) position when transmitter A is to be worked on.

Diversity Rack---Set the MODE SELECTOR switch on the controller door to A OPER when transmitter B is to be worked on, or to B OPER when transmitter A is to be worked on.

Refer to transmitter assembly drawings in Chapter 6 Section I for location and identification of subassemblies.

TRANSMITTER DOOR

1. Open the transmitter door and disconnect the power plug from J107 and the ground wire from the ground bus on the inside of the rack.

NOTE

The transmitter doors are fastened to the rack by interlocking pins between the doors. Refer to applicable assembly drawings in Chapter 6 Section I. When one transmitter door has been removed, do not open the other because it is not secured by the pins.

2. Stabilize the door with one hand, use a small screwdriver to push the guide pins upward one at a time, and remove the door.

3. Install replacement transmitter door by inserting lower pin first, then depress the upper pin and position the doors so the upper pin will lock in place.

4. Connect the ground wire to rack ground bus.

5. Connect the power plug to J107.

NOTE

If the transmitter AFC amplifier and/or sensing unit have been replaced as a part of the door, perform the related TRANSMITTER AFC and FAULT SENSING inservice checkout procedures given in LBI-16048.

6. Set the AFC ON-AFC SET switch to its AFC ON position.

AFC AMPLIFIER AND SENSING UNIT CIRCUIT CARDS

1. Open the transmitter door and inner swing-out panel.

2. Disconnect the power plug from J107 on the door.

3. Remove the circuit card by pulling towards you.

4. Carefully insert new card in the slot being careful not to damage jacks or pins.

5. Reconnect the power plug to J107.

6. Perform the associated inservice checkout procedure as specified in either the TRANSMITTER AFC or FAULT SENSING section of LBI-16048.

AFC CONTROL PANEL (located on the transmitter door)

The AFC control panel is normally repaired while mounted on the door. When access to the back of the control panel is necessary, proceed as follows.

1. Remove the power plug from J107.

2. Remove the two retaining screws from the cover over the AFC amplifier circuit card.

3. Use an L-shaped Phillips screwdriver to loosen the two screws on the right side of the control panel and swing it outwards.

4. Reverse the procedure given above to replace the control panel.

TRANSMITTER RF OSCILLATOR CHASSIS

1. Loosen the screw on each end of the chassis, disconnect semi-rigid coax from the isolator output and pull towards you.

2. Disconnect the BNC cables from jacks J2 and J4, and the power plug from jack J1.

3. A new unit is installed by reversing steps 1 and 2.

CRYSTAL CONTROLLED AFC

1. Open transmitter door and disconnect the power plug from J107.

2. Disconnect coaxial cables from connectors J2, J4 and J5.

3. Pull the in-line power connector leading to the AFC unit apart.

4. Remove the waveguide flange screws that fasten the crystal AFC to the waveguide.

5. Remove crystal AFC mounting hardware from mounting flange.

6. Reverse the preceding steps to install a repaired or replacement crystal AFC.

7. Perform the inservice checkout procedure given in the TRANSMITTER AFC section of LBI-16048.

70 MHZ OSCILLATOR AND AFC ALARM

1. Open vent door and disconnect cable and plug from jacks J1 and J2.

2. Remove the unit by removing the four screws on front.

3. A repaired or replacement 70 MHz oscillator or AFC alarm are installed by reversing steps 1 and 2.

4. Perform the inservice checkout procedure given in the TRANSMITTER AFC section of LBI-16048.

RF AMPLIFIER, ISOLATOR AND MULTIPLIER

The procedure for removal and replacement of the RF amplifier, isolator and multiplier is given below. If the back of the rack is accessible, the entire heat sink assembly can be removed from the rack as described in step 2, and the RF amplifier, isolator or multiplier can then be easily removed or replaced. Should it be necessary to remove these items from the front of the rack, use steps 3, 4, 5 and 6. Step 3 describes how to remove or replace the multiplier. Steps 3, 4 and 5 need to be performed to remove or replace the isolator. Perform steps 4 and 6 to remove or replace the RF amplifier.

1. Turn the rack power supply that furnishes input voltages to the transmitter OFF.

2. If the back of the rack is accessible, the entire heat sink assembly (consisting of RF amplifier, isolator and multiplier) can be removed as follows.

   a. Disconnect the semi-rigid coax from both the RF amplifier input and the coax-to-waveguide transition.

CAUTION

Care should be taken when removing the semi-rigid coax that connects the output of the multiplier to the coax-to-waveguide transition to keep from damaging it. This coax must be used with the same transition to maintain the proper return loss. When reconnecting the semi-rigid coax, it should be tightened to a torque of 8 inch-pounds.

b. Disconnect the power connector from J3 on the RF amplifier.

c. Remove the heat sink assembly by taking out the six mounting screws.

d. The heat sink assembly can be installed in the rack by reversing 2a, 2b and 2c.

3. Multiplier removal and replacement:

a. Loosen the semi-rigid coax at the multiplier output and disconnect it from the coax-to-waveguide transition.

b. Remove the two mounting screws from the multiplier and disconnect the multiplier from the isolator.

c. The multiplier can be replaced by reversing steps 3a and 3b.

NOTE

If the multiplier installed is a spare that is to be used until a factory- or bench-tuned unit is available, perform the multiplier tuning procedure given in the IN-RACK TUNING PROCEDURES section of LBI-16054.

4. The RF oscillator chassis must be removed to gain access to the isolator and RF amplifier. Proceed as follows.

a. Remove the baseband input "tee" from J4 on the oscillator chassis.

b. Remove the service channel input from J2 on the oscillator chassis.

c. Disconnect the semi-rigid coax from the input of the RF Amp.

d. Remove the oscillator chassis and disconnect dc power connector J1.

e. The oscillator chassis can be replaced by reversing steps 4a, 4b and 4c.

5. Isolator removal and replacement.

a. Remove the two 5/16-inch nuts on the isolator mounting bracket.

b. Disconnect the semi-rigid waveguide from the isolator input and remove the isolator from the heat sink.

c. The circulator shipping plate and associated hardware may be discarded after the rack has been installed at its designated station.

d. The isolator can be replaced by reversing steps 5a and 5b.

6. RF amplifier removal and replacement:

a. Disconnect the semi-rigid coax from the isolator input.

b. Remove the two mounting screws from the RF amplifier and remove the amplifier and the semi-rigid coax connected to its output from the heat sink.

c. The RF amplifier can be replaced by reversing steps 6a and 6b.

BENCH MAINTENANCE

Bench maintenance procedures enable the test technician to set up a subassembly or circuit card in a test configuration, check out the unit, and isolate a malfunction. Separate bench test procedures are provided for the following: (1) Transmitter RF Oscillator Chassis, (2) Regulator and AFC Start, (3) Transmitter Baseband Amplifier, (4) Transmitter AFC Amplifier, (5) Transmitter AFC Unit, (6) 70 MHz Reference Oscillator, (7) 360 MHz Reference Oscillator, (8) AFC Alarm, (9) RF Power Amplifier, (10) RF Multiplier and (11) Transmitter Sensing Unit.

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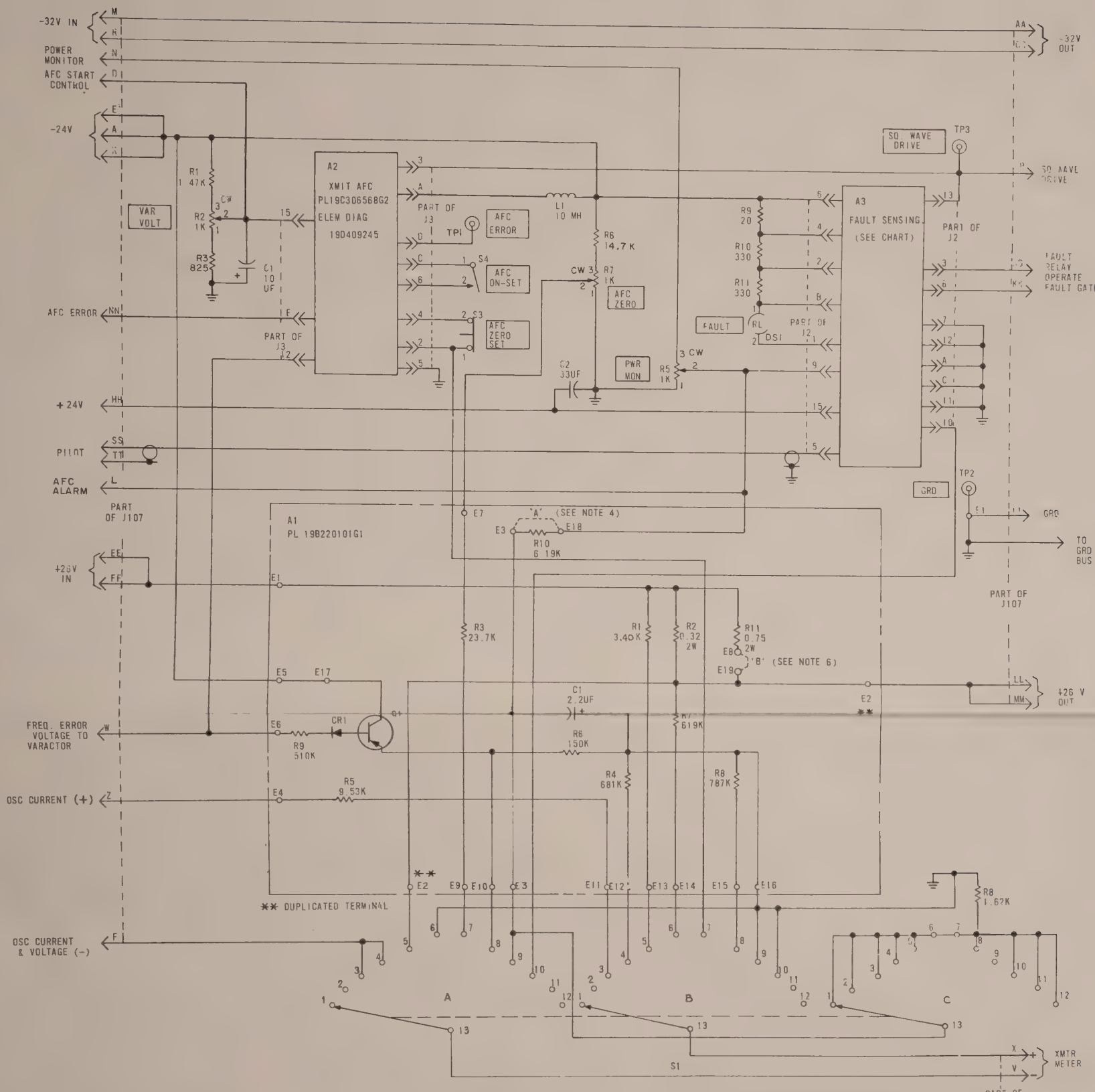


SEMI CONDUCTOR CHART

ITEM NO.	G.E. IDENT. NO.	SIMILAR TO * JEDEC REG NO
A1CR1	19A115250P1	SSD-753
A1Q1	19A115852P1	2N 3906

* FOR REFERENCE ONLY NOT RECOMMENDED FOR EXACT REPLACEMENT.

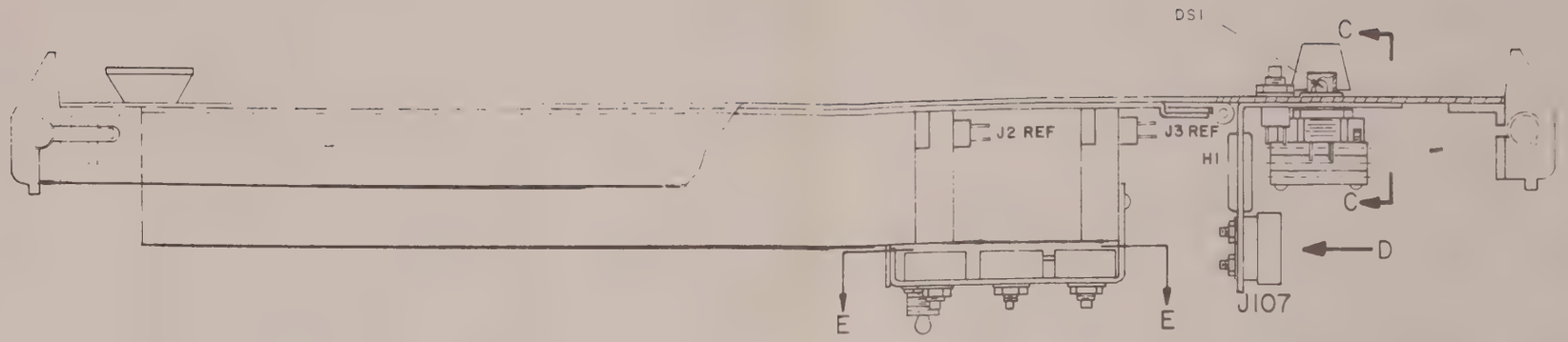
SW POS	S1 FUNCTION
1	
2	
3	OSC. CURRENT
4	OSC. VOLTAGE
5	AMPL. CURRENT
6	AMPL. VOLTAGE
7	AFC
8	VARACTOR VOLTAGE
9	POWER
10	PILOT
11	
12	

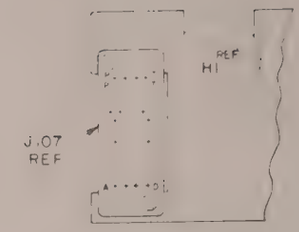
PL19D405286 GP IDENTIFICATION

GP	AFC	SENSING	FAULT SENSING UNIT
8	CRYSTAL REF	NONE	
9	CRYSTAL REF	2.1 MHZ	PL 19C313458G3 ELEM DIAG. 19D405809
10	CRYSTAL REF	3.2 MHZ	PL 19C313458G1 ELEM DIAG 19D405809
11	CRYSTAL REF	2.1 MHz (LOW POWER)	PL 19C313458G6 ELEM DIAG 19D405430
12	CRYSTAL REF	3.2 MHz (LOW POWER)	PL 19C313458G4 ELEM DIAG 19D405430
13	CRYSTAL REF	8.5 MHz	PL 19C313458G2 ELEM DIAG 19D405809

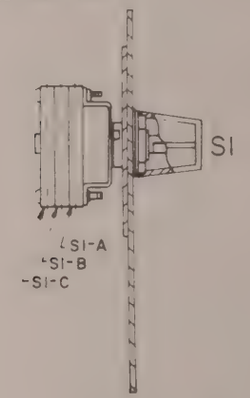
NOTES:
1. ALL RESISTORS ARE 1/2 WATT UNLESS OTHERWISE SPECIFIED AND RESISTOR VALUES IN OHMS UNLESS FOLLOWED BY K=1000 OHMS OR MEG = 1,000,000 OHMS. CAPACITOR VALUES IN PICOFARADS (EQUAL TO MICROMICROFARADS) UNLESS FOLLOWED BY UF= MICROFARADS. INDUCTANCE VALUES IN MICROHENRYS UNLESS FOLLOWED BY MH= MILLIHENRYS OR H=HENRYS.
2. PINS 'J' & A, 2 & B THRU 15 & S OF J2 ARE SHORTED WHEN FAULT SENSING UNIT IS REMOVED
3. SUBASSEMBLY REFERENCE DESIGNATIONS ARE ABBREVIATED. PREFIX THE DESIGNATION WITH SUBASSEMBLY DESIGNATION.
4. ADD JUMPER 'A' BETWEEN A1E3 & A1E18 FOR LOW POWER XMTR. GROUPS 11 & 12
5. ▭ INDICATES FRONT PANEL MARKING.
6. ADD JUMPER 'B' BETWEEN A1-E8 & A1-E19 WHEN BOARD IS USED IN GROUP 13 TRANSMITTER DOOR

Elementary Diagram
TRANSMITTER DOOR
PL-19D405286-G8 thru -G13
(Drawing No. 19D409254, Rev. 2)

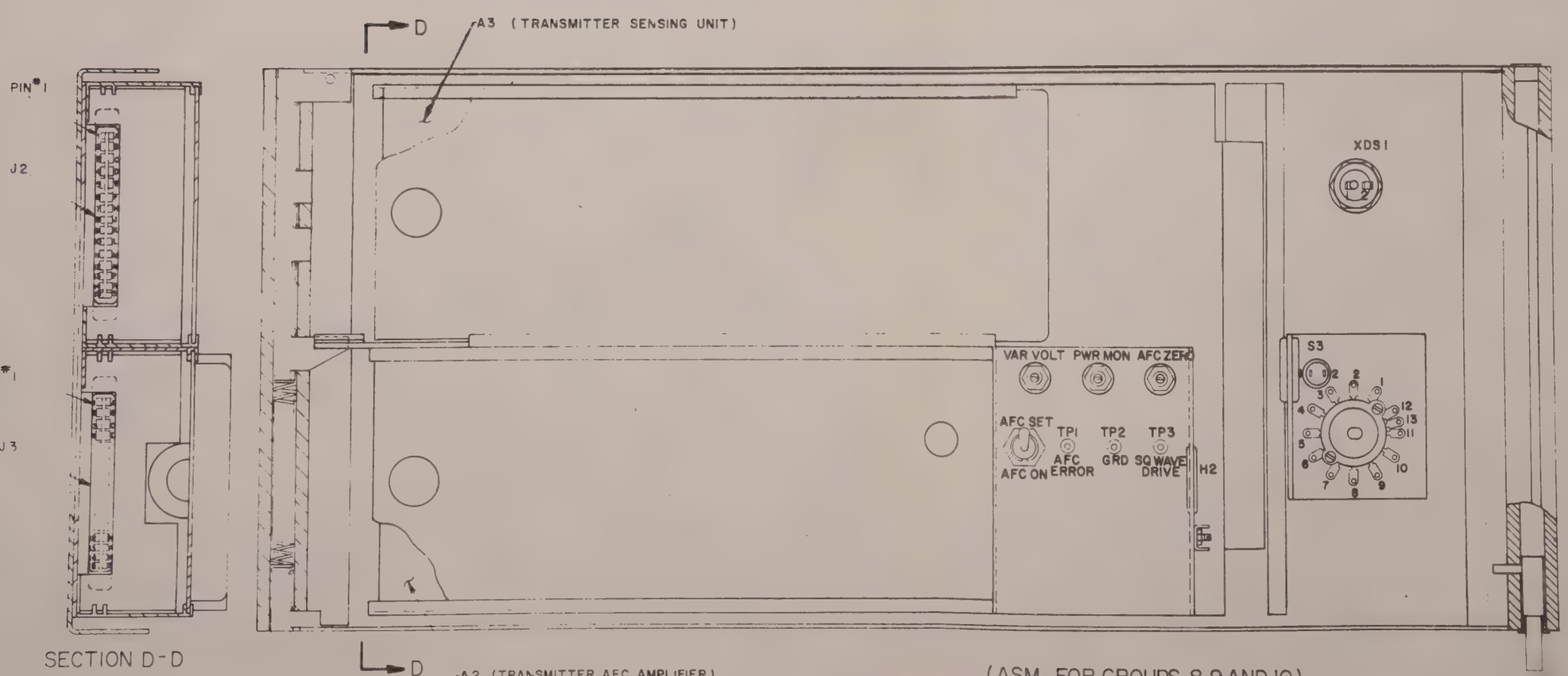




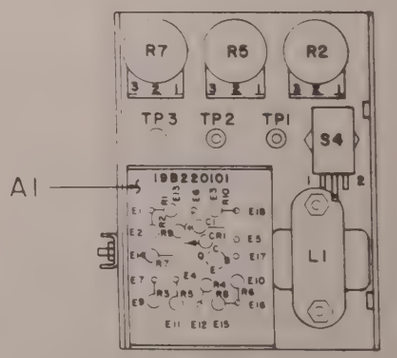
VIEW D
ROTATED 90° CW



SECTION C-C
ROTATED 90° CW



SECTION D-D



SECTION E-E
ROTATED 180°

(ASM. FOR GROUPS 8,9 AND 10)
(FOR GROUPS 11 & 12 (LOW POWER XMTR). ADD DA WIRE JUMPER BETWEEN AIE 3 AND AIE 18).

Service Outline

TRANSMITTER DOOR (SOLID STATE)
PL-19D405286-G8 thru G12

(Drawing No. 19D409745, Rev. 0)

PARTS LIST

TRANSMITTER DOOR
19D405286G8-G12

SYMBOL	GE PART NO.	DESCRIPTION
A1		COMPONENT BOARD 19B220101G1
		- - - - - - - - - - CAPACITORS - - - - - - - - - -
C1	5496267P13	Tantalum: 2.2 µf ±20%, 20 VDCW; sim to Sprague Type 150D.
		- - - - - - - - DIODES AND RECTIFIERS - - - - -
CR1	19A115250P1	Silicon.
		- - - - - - - - - - TRANSISTORS - - - - - - - - - -
Q1	19A115852P1	Silicon, PNP; sim to Type 2N3906.
		- - - - - - - - - - RESISTORS - - - - - - - - - -
R1	19A116278P252	Metal film: 3400 ohms ±2%, 1/2 w.
R2	19A115416P11	Wirewound: 0.32 ohms ±1%, 2 w; sim to Dale Type RS-2B.
R3	19A116278P337	Metal film: 23,700 ohms ±2%, 1/2 w.
R4	19A116278P481	Metal film: 681,000 ohms ±2%, 1/2 w.
R5	19A116278P295	Metal film: 9530 ohms ±2%, 1/2 w.
R6	3R77P154J	Composition: 0.15 megohm ±5%, 1/2 w.
R7	19A116278P477	Metal film: 619,000 ohms ±2%, 1/2 w.
R8	19A116278P487	Metal film: 787,000 ohms ±2%, 1/2 w.
R9	3R77P514J	Composition: 0.51 megohm ±5%, 1/2 w.
R10	19A116278P277	Metal film: 6190 ohms ±2%, 1/2 w.
A2	19C306568G2	AFC Amplifier Board. (Used in G8 only- Refer to LBI-16060).
A3	19C313458G6	Transmitter Board. (Used in G11 only- Refer to LBI-16063).
A3	19C313458G1	Transmitter Board. (Used in G10 only- Refer to LBI-13908).
A3	19C313458G3	Transmitter Board. (Used in G9 only- Refer to LBI-13908).
A3	19C313458G4	Transmitter Board. (Used in G12 only- Refer to LBI-16063).
		- - - - - - - - - - CAPACITORS - - - - - - - - - -
C1	19A115680P8	Electrolytic: 10 µf +150% -10%, 25 VDCW; sim to Mallory Type TT. (Used in G8 only).
C2	19A116080P110	Polyester: 0.33 µf ±10%, 50 VDCW. (Used in G8 only).
		- - - - - - - - INDICATING DEVICES - - - - - - - -
DS1	19A115825P1	Lamp, incandescent: 28 v; sim to Drake 2840. (Used in G8 only).
		- - - - - - - - JACKS AND RECEPTACLES - - - - - - - -
J2	19B209014P1	Connector, printed wiring: (Double-sided), 15 contact pairs; sim to Precision Connectors Inc 60-062SW-15-014. (Used in G8 only).
J3	5496085P2	Connector, printed board: 30 contacts; sim to Methode 80 Series 6030-1155-00. (Used in G8 only).
J107	19B209227P7	Connector, plug: 38 contacts; sim to Elco Corp. 00-8016-038-000-013. (Used in G8 only).
		- - - - - - - - - - INDUCTORS - - - - - - - - - -
L1	19A115743P1	Reactor: 10.1 mh at .500 amp DC, 1.2 ohms DC res max, 24 VDC operating. (Used in G8 only).

SYMBOL	GE PART NO.	DESCRIPTION
		- - - - - - - - - - RESISTORS - - - - - - - - - -
R1	19A116278P217	Metal film: 1470 ohms ±2%, 1/2 w. (Used in G8 only).
R2	7487391P121	Variable, carbon film: 1000 ohms ±20%, 0.3 w. (Used in G8 only).
R3	19A116278P189	Metal film: 825 ohms ±2%, 1/2 w. (Used in G8 only).
R5	5494774P102	Variable, carbon film: 1000 ohms ±20%, 0.3 w; sim to CTS Series 70 Control. (Used in G8 only).
R6	19A116278P317	Metal film: 14,700 ohms ±2%, 1/2 w. (Used in G8 only).
R7	5494774P102	Variable, carbon film: 1000 ohms ±20%, 0.3 w; sim to CTS Series 70 Control. (Used in G8 only).
R8	5495948P277	Deposited carbon: 6190 ohms ±1%, 1/2 w; sim to Texas Instrument CDI/2MR. (Used in G8 only).
R9	3R77P200J	Composition: 20 ohms ±5%, 1/2 w. (Used in G8 only).
R10 and R11	3R77P331J	Composition: 330 ohms ±5%, 1/2 w. (Used in G8 only).
		- - - - - - - - - - SWITCHES - - - - - - - - - -
S1	19C307060P8	Rotary: 3 section, 12 position, 3 poles; sim to CTS 222. (Used in G8 only).
S3	7481654P8	Push button: Momentary contact, SPNC, 1/10 amp at 115 VAC, non-inductive; sim to Alcor 425-1. (Used in G8 only).
S4	7478623P1	Toggle: SPST, 3 amps at 250 VDC; sim to Arrow-Hart and Hegeman 20994-BJC. (Used in G8 only).
		- - - - - - - - - TEST POINTS - - - - - - - - -
TP1	19A116368P1	Jack, tip: sim to EF Johnson 105-1041. (Used in G8 only).
TP2	19A116368P3	Jack, tip: sim to EF Johnson 105-1043. (Used in G8 only).
TP3	19A116368P1	Jack, tip: sim to EF Johnson 105-1041. (Used in G8 only).
		- - - - - - - - - - SOCKETS - - - - - - - - - -
XDS1	19B201122P2	Lampholder: sim to Drake Mfg 121 Series. (Used in G8 only).

*COMPONENTS ADDED, DELETED OR CHANGED BY PRODUCTION CHANGES

Chapter 4 Section I

PRINCIPLES OF OPERATION

TRS-696B TRANSMITTER RF OSCILLATOR PL-19D409274-G1, -G2, G3

GENERAL

The transmitter RF oscillator chassis contains the transmitter baseband amplifier, voltage regulator and AFC start circuits, RF oscillator/modulator, harmonic absorber, an isolator and the components used to filter the -24, +26 and -32 Vdc inputs.

The transmitter baseband amplifier raises the level of composite baseband (message channels) and (optional) service channel signals applied to it to the level required to drive the modulator in the RF oscillator/modulator.

The voltage regulator AFC start circuits serve two functions. The voltage regulator portion provides the stable operating voltage required by the RF oscillator/modulator. The AFC start portion provides an output control voltage used to charge the AFC amplifier output capacitors very quickly after the power supply is turned on; this prevents development of a "lock-out" (the inability of the AFC to pull the transmitter on-frequency) condition in the AFC loop.

The RF oscillator/modulator is a solid state RF signal source whose frequency is both mechanically and electrically adjustable. This oscillator, which operates in the 1.64 to 1.72 GHz or 1.48 to 1.61 GHz frequency range, is modulated by signal from the baseband amplifier, and AFC controlled by a control voltage from the AFC circuits. These two inputs are applied to a single varactor diode. The RF output, which is ultimately fed into a multiplier and raised to the assigned transmitter frequency, is taken through a harmonic absorber and an isolator.

The baseband amplifier and regulator and AFC start circuits are printed wire boards that are bolted to the chassis. The oscillator/modulator, harmonic absorber and isolator are subassemblies; the oscillator/modulator is mounted inside the chassis, while the harmonic absorber and isolator are mounted outside the chassis. Except for BNC signal jacks and RF output jack, all connections to the chassis are made at J1, which mates with rack cable plug P19 or P20.

SPECIFICATIONS

RF Oscillator/Modulator*

Input Voltage:	-20 to -27.5 Vdc
AFC Voltage:	-19 to -23 Vdc
Modulation Sensitivity:	2.5 - 10 MHz/volt
Output Frequency:	1.64 to 1.72 GHz for PSIT 1.48 to 1.61 GHz for CC

Output Power: (isolator output)	1.0 - 1.6 watts (depending on transmitter type and frequency)

*Detailed specifications for the baseband amplifier are in LBI-16072, and for the regulator and AFC start are in LBI-16070.

CIRCUIT DESCRIPTION

The circuit description of the transmitter RF oscillator is given in the following parts: (1) transmitter baseband amplifier, (2) voltage regulator and AFC start, (3) RF oscillator/modulator, (4) harmonic absorber and isolator, and (5) dc power circuits. All of these, with the exception of the harmonic absorber, are made with reference to Elementary Diagram 19D409273; the harmonic absorber is described with reference to Elementary Diagram 19A103595. Refer to Service Outline 19D409595 for location of parts.

Transmitter Baseband Amplifier:

The transmitter baseband amplifier has two signal inputs. One of these is BB INPUT jack J4 for the composite baseband (message channels), and the other is SC INPUT jack J2 for signal from the (optional) service channel unit. Signal applied to the amplifier is raised to the level required to drive the modulator in the RF oscillator/modulator. Amplifier output is applied to the modulator through A2-J8 and Y1-C5. Amplifier specifications and a detailed circuit description are presented in LBI-16072.

Voltage Regulator and AFC Start Circuits:

The regulator and AFC start circuits provide the regulated supply voltage required by the oscillator/modulator, and a control voltage to the AFC loop for a brief time after the power supply is turned on.

Supply voltage for the oscillator/modulator, -32 Vdc, is applied at A1-J1. The regulator circuit samples the voltage at A1-E3, compares the sample to a reference voltage supplied by a zener diode, and uses any difference that may exist between sample and reference to control series regulator Q1. The regulated output taken from A1-E3 is connected to Y1-FL1 on the oscillator/modulator.

The AFC start control voltage, supplied by the VAR VOLT output, is applied at A1-J3. The start control output at A1-J9 is a low impedance voltage source whose level is the sum of the control voltage plus a fixed zener voltage that represents static AFC amplifier output. This voltage is connected to the oscillator/modulator and, through J1-A5, to the output of the AFC amplifier where it will immediately charge the output capacitors so a "lock-out" will not develop in the AFC loop. About six seconds after the power supply is turned on, the AFC start circuit is opened and has no further influence on the AFC loop.

Detailed circuit specifications and descriptions of each of these circuits are presented in LBI-16070.

RF Oscillator/Modulator

The oscillator consists of a grounded collector transistor and a resonant coaxial cavity with two coaxial probes. It is modulated via one probe, and RF power is coupled out by the other. Frequency can be adjusted mechanically or electrically; mechanically by changing cavity center conductor length, electrically through the modulator probe by changing modulator varactor bias. Two dc supply lines to transistor oscillator Y1-Q1 pass through the cavity wall. Capacitors Y1-C2 and Y1-C3 provide an RF short located approximately a quarter-wavelength from the transistor on their respective supply lines. The RF shorts minimize dc-to-RF interaction.

A second cavity, located inside the oscillator block and between the RF shorts and dc inputs, contains bias and filtering components. The supply lines enter through low-pass filters Y1-FL1 and Y1-FL2. A bias resistor, consisting of Y1-R1 and Y1-R2 in parallel, is in series with the emitter supply line. An RF choke (Y1-L1) is in series with the base supply line. The choke and capacitor Y1-C1 connected from the base to ground eliminate any possible spurious oscillations. Inductor L4 and capacitors C4 and C5 form a low frequency noise filter external to the oscillator.

The modulator input is at Y1-C5. This is connected to the modulator probe that couples tuning varactor Y1-CV1 to the oscillator cavity. Output frequency can be adjusted electrically by changing the dc bias applied to the varactor. Once the transmitter is tuned to its assigned frequency by a combination of mechanical and electrical adjustments, varactor bias (and therefore the output frequency) is controlled by the AFC circuitry. The dc bias and AFC circuits are connected to the modulator input. Frequency modulation of the carrier (about a center-frequency determined by varactor bias) is achieved by applying baseband output signal to the modulator input.

Modulated RF power is taken from the oscillator at Y1-J1, and passed through harmonic absorber FL1 and isolator A3. The output of the RF oscillator chassis is taken at J1 on the isolator. Output level is set by adjusting a control (A1-R13) on regulator and AFC start board A1. In the UT-10-C transmitter, oscillator output is used to drive the RF power amplifier, and output level is adjusted to maintain maximum efficiency in the amplifier. Oscillator output is fed into the X4 multiplier in the UT-10-D (lower power) transmitter, and output level is set for 1.6 watts. Modulation sensitivity and linearity are set by adjusting the modulator as described in maintenance procedures given in Chapter 5 Section I.

Harmonic Absorber and Isolator:

The harmonic absorber is a combination low-pass and high-pass filter designed to pass the oscillator fundamental frequency and provide a resistive termination for oscillator harmonic frequencies. Refer to Elementary Diagram 19A103595. Signal from the oscillator is applied at P1. Low-pass filter L1-L3-C3 passes the oscillator fundamental frequency to output jack J1 with less than 0.25 dB insertion

loss. High-pass filter C1-C2-L2 passes harmonic frequencies to termination resistor R1. Signal from the harmonic absorber is passed through a ferrite isolator that provides 20 dB of isolation from reflected fundamental frequency power.

DC Power Circuits:

Three input voltages, -24 Vdc, -32 Vdc and +26 Vdc, are applied to the RF oscillator chassis.

The AFC start circuit and baseband amplifier use the -24 Vdc input. It is applied at J1-B2 and connected into the AFC start circuit at A1-J2, and through filter C3-L3 to A2-J1 on the baseband amplifier.

Power for the oscillator/modulator is supplied by the -32 Vdc source. This is applied at J1-B1 and through filter L2-C2 to the regulator circuit at A1-J1. Regulator output appears at A1-E3 and is applied to the collector of driver transistor Q2 and to the oscillator/modulator at Y1-FL1. Bias at A1-E4 is applied to the base of Q2, while the emitter resistor for Q2 is provided at A1-E5. Driver output at the emitter of Q2 is applied to Y1-FL2. Capacitors C4 and C5 provide filtering. Chassis mounted transistor Q1 is the series regulator. A1-J7 and A1-J8 provide for voltage and current metering and are connected into the metering circuit through J1-A2 and J1-A3 respectively.

The +26 Vdc input is required for the RF power amplifier. Therefore it is needed only in the UT-10-C transmitter. It is applied at J1-A1, filtered by L1-C1, and connected to the power amplifier by J1-A6.

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MAINTENANCE

TRS-696B TRANSMITTER RF OSCILLATOR CHASSIS PL-19D409274-G1

GENERAL

Bench maintenance procedures for the transmitter RF oscillator chassis consist of: (1) visual inspection of components, solder connections, plug-in terminals and chassis jacks, and (2) continuity checks. Refer to Elementary Diagram 19D409273 and Service Outline 19D409595.

TEST EQUIPMENT

The following item of test equipment (or the equivalent) is required.

Multimeter	Simpson 269 or Triplett 630

MAINTENANCE PROCEDURES

The RF oscillator chassis contains the transmitter baseband amplifier, regulator and AFC start circuits, RF oscillator/modulator and associated filters and interconnection wiring. In addition, a harmonic absorber and a ferrite isolator are mounted outside the chassis. Refer to LBI-16073 for a baseband amplifier maintenance procedure, and to LBI-16071 for a regulator and AFC start circuit maintenance procedure. Additional procedures for the RF oscillator chassis and baseband amplifier, and an in-rack tuning procedure for the RF oscillator/modulator are given in LBI-16054. No maintenance procedures are provided for the harmonic absorber or ferrite isolator.

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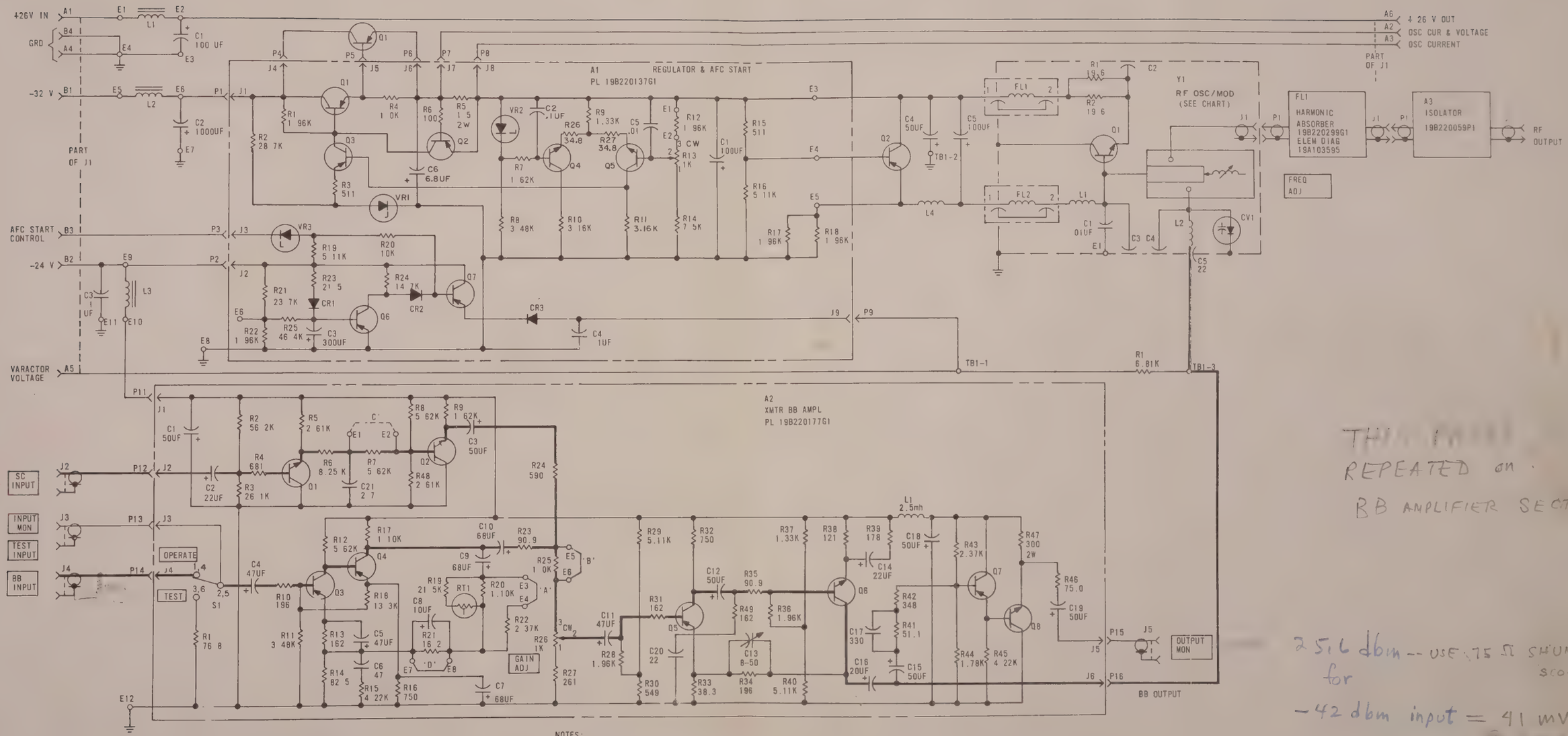


SEMI CONDUCTOR CHART

ITEM NO.	G E. IDENT NO	SIMILAR TO * JEDEC REG NO.
Q1	19A116375P1	TIP 32A
Q2	19A115562P1	
A1CR1	4038056P1	
A1CR2, A1CR3	19A115250P1	SSD-753
A1VR1, A1VR2	4036887P51	
A1VR3	4036887P53	
A1Q1	19A115562P1	
A1Q2 A1Q3 A1Q6, A1Q7	19A115852P1	2N3906
A1Q4, A1Q5	19A115362P1	
A2Q1, A2Q2	19A115910P1	2N3904
A2Q3, A2Q4, A2Q5, A2Q7	19A115852P1	2N3906
A2Q6, A2Q8	19A115591P1	2N2218A
Y1 Q1	19A103328P1	
Y1 CV1	19A116498P1	

* FOR REFERENCE ONLY NOT RECOMMENDED FOR EXACT REPLACEMENT

NOTES:

1. ALL RESISTORS ARE 1/2 WATT UNLESS OTHERWISE SPECIFIED AND RESISTOR VALUES IN OHMS UNLESS FOLLOWED BY K=1000 OHMS OR MEG=1,000,000 OHMS, CAPACITOR VALUES IN PICOFARADS (EQUAL TO MICROMICROFARADS) UNLESS FOLLOWED BY UF= MICROFARADS. INDUCTANCE VALUES IN MICROHENRYS UNLESS FOLLOWED BY MH= MILLIHENRYS OR H=HENRYS.
2. [ ] INDICATES FRONT PANEL MARKING.
3. SUBASSEMBLY REFERENCE DESIGNATION ARE ABBREVIATED. PREFIX THE DESIGNATION WITH SUB ASSEMBLY DESIGNATION.
4. FOR -45 dBm/CHANNEL INPUT REMOVE JUMPER 'A' BETWEEN A2E3 & A2E4. FOR 6.5 dB UNDER DEVIATION REMOVE JUMPER 'B' BETWEEN A2E5 & A2E6. FOR NON-EMPHASIZED LOADING ADD JUMPER 'C' BETWEEN A2E1 AND A2E2. FOR 300 Hz 0.1 dB BOOST REMOVE JUMPER 'D' BETWEEN A2E7 AND A2E8.

19D409274 GP. IDENTIFICATION

GP.	Y1 RF OSC/MOD	DESCRIPTION
1	19C316189G1	HIGH POWER XMTR
2	19C316189G2	LOW POWER XMTR

THIS PAGE REPEATED ON BB AMPLIFIER SECTION

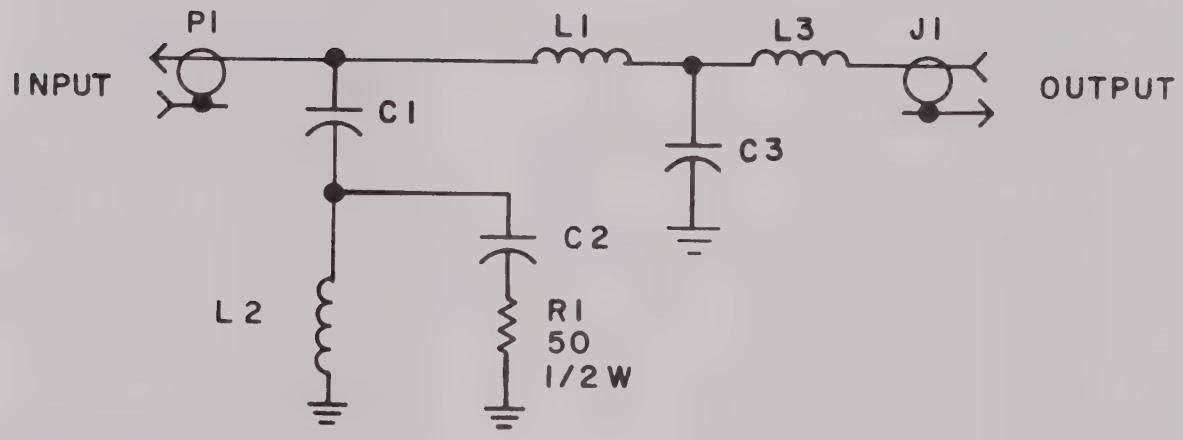
25.6 dbm -- USE 75 Ω SHUNT and SCOPE for -42 dbm input = 41 mV OUTPUT

BB AMPL., AFC START

Elementary Diagram

TRANSMITTER RF OSCILLATOR
PL-19D409274-G1, G2

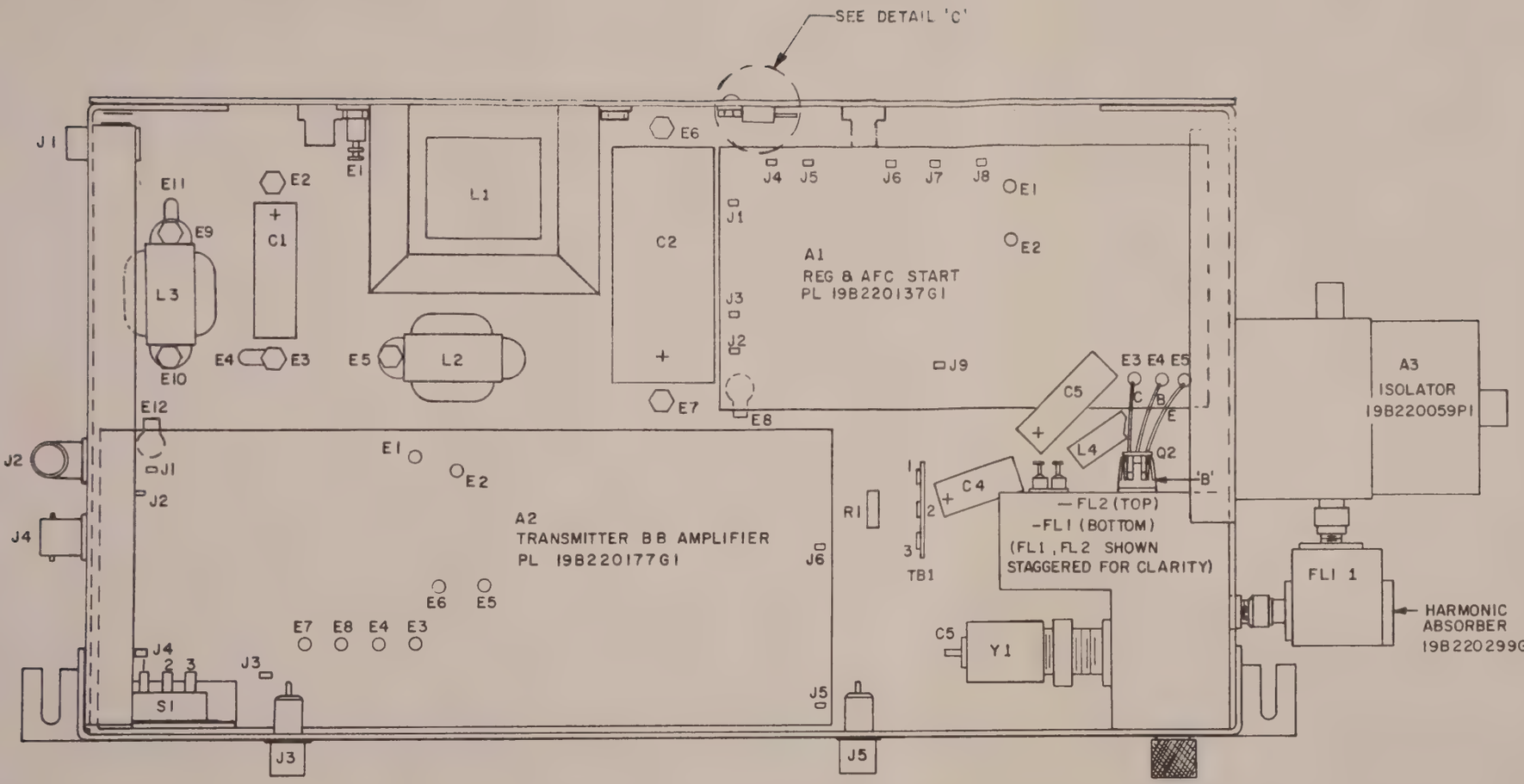
(Drawing No. 19D409273, Rev. 2)

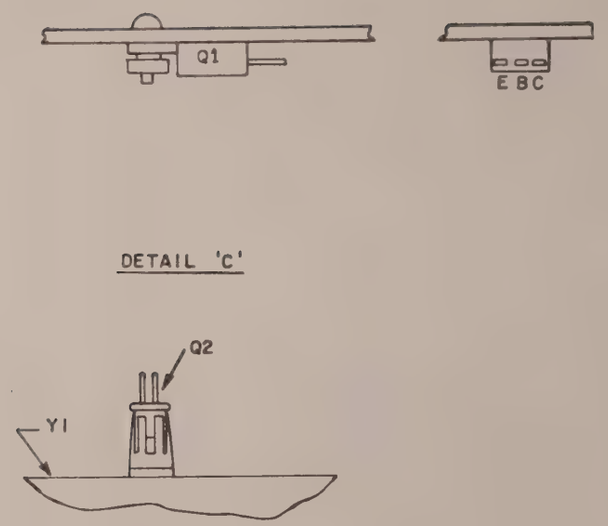


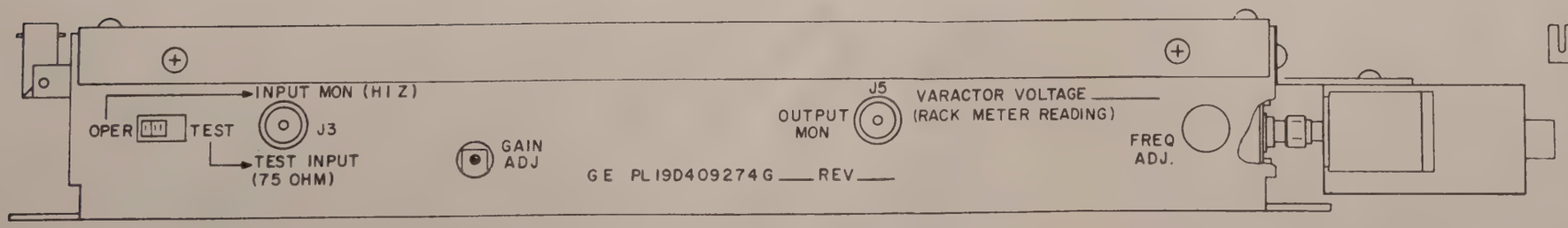
Elementary Diagram

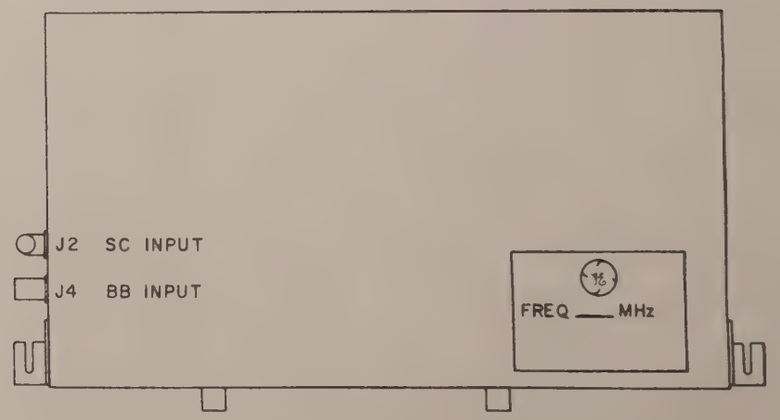
HARMONIC ABSORBER
PL-19B220299-G1

(Drawing No. 19A103595, Rev. 0)









Service Outline

TRANSMITTER RF OSCILLATOR
PL-19D409274-G1

(Drawing No. 19D409595, Rev. 0)

PARTS LIST

TRANSMITTER RF OSCILLATOR
19D409274G1

SYMBOL	GE PART NO.	DESCRIPTION
A1	19B220137G1	Regulator and AFC Start. (Refer to LBI-16065).
A2	19B220177G1	Transmitter Baseband Amplifier. (Refer to LBI-16066).
A3	19B220059P1	Isolator. (1640-1720 MHz Freq range, 35 db max insertion loss).
		- - - - - - - - - CAPACITORS - - - - - - - - -
C1	19A115680P12	Electrolytic: 100 µf +150% -10%, 30 VDCW; sim to Mallory Type TT.
C2	5493132P1	Electrolytic: 1000 µf +250% -15%, 35 VDCW.
C3	19B209243P7	Polyester: 0.1 µf ±20%, 50 VDCW.
C4	19A115680P6	Electrolytic: 50 µf +150% -10%, 50 VDCW; sim to Mallory Type TT.
C5	19A115680P7	Electrolytic: 100 µf +150% -10%, 15 VDCW; sim to Mallory Type TT.
		- - - - - - - - - - FILTERS - - - - - - - - - -
FL1	19B220299G1	Harmonic Absorber.
		- - - - - - - JACKS AND RECEPTACLES - - - - - -
J1	19B209427P3	Plug: 12 contacts, 8.5 amps, 600 VRMS; sim to Elco 00-8024-012-000-003.
J2	7776570P18	Receptacle, right angle: coaxial, 500 v peak. Military Type UG-1098/U.
J3 thru J5	7776570P17	Receptacle, bulkhead: coaxial, 500 v peak. Military Type UG-1094/U.
		- - - - - - - - - - INDUCTORS - - - - - - - - -
L1	19A115797P1	Reactor: 1 mh min, 0.1 ohm DC res max, 48 VDC operating.
L2 and L3	19A115743P1	Reactor: 10.1 mh at .500 amp DC, 1.2 ohms DC res max, 24 VDC operating.
L4	19A155987P1	Bead Choke, RF: sim to National Radio R45-254.
		- - - - - - - - - - PLUGS - - - - - - - - -
P1 thru P16	19A116453P1	Contact, electrical: sim to Malco 12100-10.
		- - - - - - - - - TRANSISTORS - - - - - - - - -
Q1	19A116375P1	Silicon, PNP.
Q2	19A115562P1	Silicon, PNP.
		- - - - - - - - - - RESISTORS - - - - - - - - -
R1	19A116278P281	Metal film: 6810 ohms ±2%, 1/2 w.
		- - - - - - - - TERMINAL BOARDS - - - - - - - -
TB1	7775500P7	Phen: 3 terminals.
		- - - - - - - - - - CRYSTALS - - - - - - - - - -
Y1	19C316189G1	RF Oscillator/Modulator. (Used in G1 only).
Y1	19C316189G2	RF Oscillator/Modulator. (Used in G2 only).

*COMPONENTS ADDED, DELETED OR CHANGED BY PRODUCTION CHANGES

PRINCIPLES OF OPERATION
RF POWER AMPLIFIER ASSEMBLY
PL-19B220526-G1 & G3

GENERAL

The microwave power amplifier assembly consists of an amplifier circuit, output terminated circulator and output interconnecting cable. It is used in the UT-10-C (high power) transmitter only, and is mounted on the heat sink fastened to the back of the rack.

SPECIFICATIONS

Frequency Range:	1.64 - 1.72 GHz
Output Power:	6.25 watts minimum at output of terminated circulator
Minimum Gain:	6.8 dB
Input Return Loss:	10 dB minimum
Input Voltage:	+26 $\pm$0.5 Vdc
CW Collector Current:	600 mA maximum
Input/Output Impedance:	50 ohms, OSM connectors

DESCRIPTION

The description that follows is made with reference to Elementary Diagram 19B220560.

The amplifier, a single stage (transistor Q1) connected in the grounded base configuration that operates in the class C mode, is contained in a shielded container. Input signal is applied to it through INPUT jack J1 and microstrip transmission line. Temperature compensation for the emitter circuit is provided by RT1 which is connected in parallel with R1. This holds the gain of the amplifier within a safe limit when it is operating at low temperatures.

Amplifier reliability is enhanced by limiting collector current to a maximum of 600 mA. Because of this restriction, it is necessary to divide the frequency range into two bands. The Group 2 assembly covers 1.64 - 1.68 GHz and the Group 3 assembly covers 1.68 - 1.72 GHz. Frequency stability at the low end of the band is provided by R3 in the collector circuit. Output signal is taken from the collector of Q1 through a microstrip transmission line and OUTPUT jack J2.

The interconnecting output cable and terminated circulator are a necessary part of this assembly because of the limitation placed on amplifier collector current. This is because the amplifier operates in class C which makes its collector current a function of the input and output match; the slight change in output match that is possible

due to different interconnecting cables and terminated circulators could cause the amplifier collector current to exceed its 600 mA limit. Signal from the terminated circulator is applied to the multiplier.

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MAINTENANCE

RF POWER AMPLIFIER ASSEMBLY
PL-19B220526-G2 & -G3

GENERAL

Detailed maintenance procedures for the RF power amplifier assembly are not provided. It is recommended that this assembly be returned to the factory for repair. Removal and replacement procedures are given in LBI-16055. However, for those users who may desire to set up the facilities for repair of this assembly, detailed procedures and a list of special test equipment required will be supplied on request. The following WARNING notice is given for those that may be involved in performance of such maintenance procedures for this assembly.

WARNING

HANDLE TRANSISTOR Q1 WITH CARE. THE CERAMIC PORTIONS OF THIS TRANSISTOR CONTAIN BERYLLIUM OXIDE, A TOXIC SUBSTANCE. IF THESE PORTIONS ARE CRUSHED, BROKEN OR ABRADED, THE DUST RESULTING FROM SUCH ACTION MAY BE HAZARDOUS IF INHALED.

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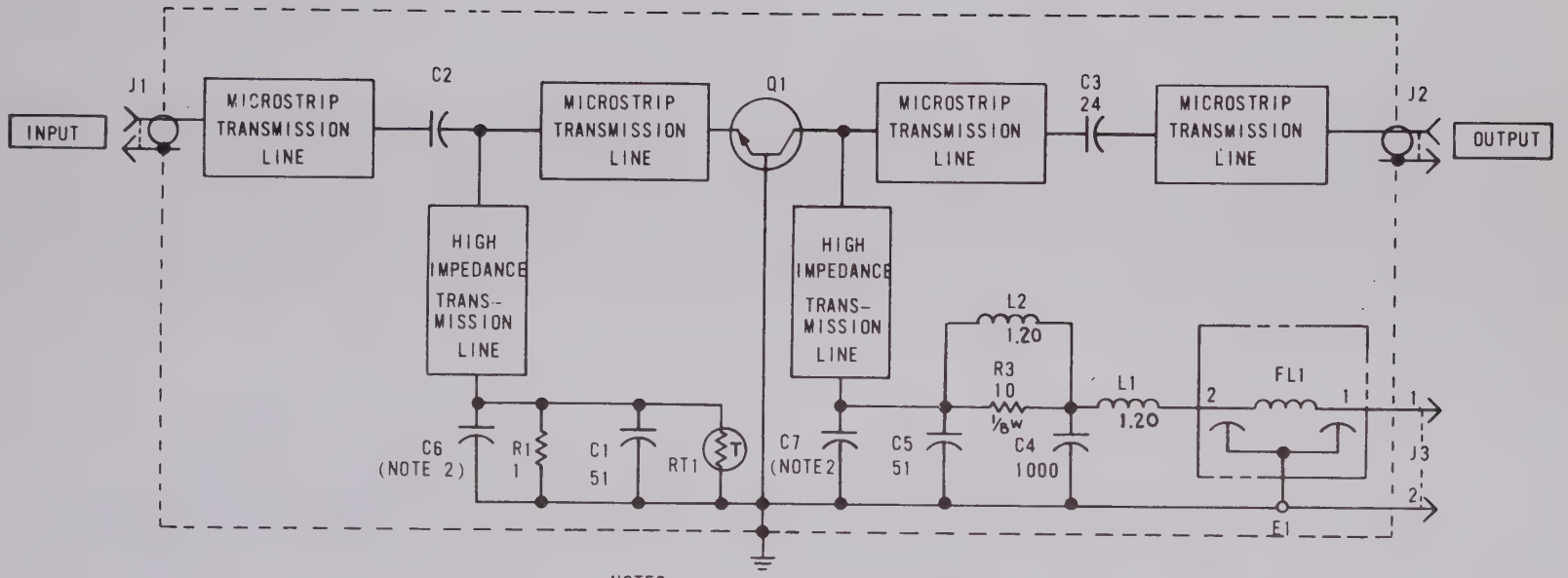

NOTES:

1. ALL RESISTORS ARE 1/2 WATT UNLESS OTHERWISE SPECIFIED AND RESISTOR VALUES IN OHMS UNLESS FOLLOWED BY K=1000 OHMS OR MEG = 1,000,000 OHMS. CAPACITOR VALUES IN PICOFARADS (EQUAL TO MICROMICROFARADS) UNLESS FOLLOWED BY UF = MICROFARADS. INDUCTANCE VALUES IN MICROHENRYS UNLESS FOLLOWED BY MH= MILLIHENRYS OR H=HENRYS.
2. C6 & C7 ARE FORMED BY PRINTED CIRCUIT PAD.

SEMI CONDUCTOR CHART

ITEM NO.	G.E. IDENT. NO	SIMILAR TO * JEDEC REG. NO.
Q1	19A103313P1	2N5921

* FOR REFERENCE ONLY NOT RECOMMENDED FOR EXACT REPLACEMENT.

Elementary Diagram

RF POWER AMPLIFIER
PL-19B220526-G1 thru G3

(Drawing No. 19B220560, Rev. 0)

PRINCIPLES OF OPERATION

RF MULTIPLIER
PL-19C313920-G1

GENERAL

The RF multiplier is used to multiply the frequency of the signal supplied by the solid-state oscillator. This is a signal in the 1.64 to 1.72 GHz frequency range that is applied to the multiplier input directly from the oscillator in the UT-10-D (low power) transmitter, or from the output of the power amplifier in the UT-10-C (high power) transmitter. Signal taken from the output of the multiplier is in the 6.575 to 6.875 GHz frequency range, and is applied to the transition section of the transmitter waveguide assembly. The multiplier is mounted on the heat sink fastened to the back of the rack.

SPECIFICATIONS

Input frequency:	1.64 to 1.72 GHz
Output frequency:	6.575 to 6.875 GHz
Instantaneous bandwidth:	40 MHz to 0.1 dB point
Harmonic attenuation:	Unwanted harmonics attenuated to -40 dB with respect to the required output frequency

DESCRIPTION

The description that follows is made with respect to Elementary Diagram 19B220567.

The circuit consists basically of two filters that are mutually coupled by a varactor diode. Signal applied to input P1 is applied to a filter designed to resonate at the frequency of the signal from the solid-state oscillator. Input signal can be monitored at J2. Varactor diode CR1 couples the input to the output filter. The output filter is designed to resonate at the desired harmonic of the signal applied to the input. Output signal is taken at J1.

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MAINTENANCE
RF MULTIPLIER
PL-19C313920-G1

GENERAL

Detailed maintenance procedures for the RF multiplier are not provided. It is recommended that this assembly be returned to the factory for repair. Removal and replacement procedures are given in LBI-16055. However, for those users who may desire to set up the facilities for repair of this assembly, detailed procedures and a list of special test equipment required will be supplied on request.

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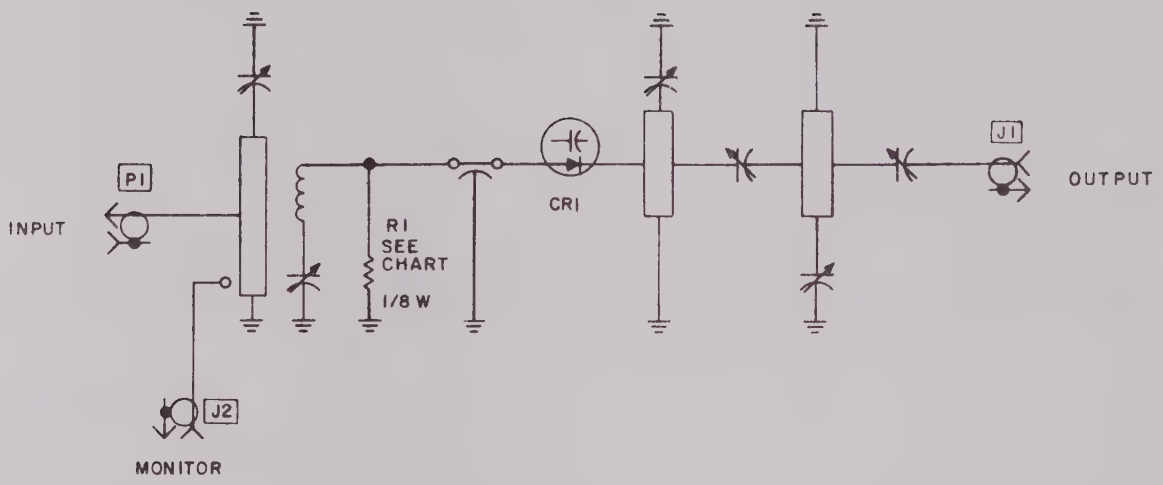

INDICATES FRONT COVER MARKING

SEMI-CONDUCTOR CHART

ITEM NO.	GE IDENT NO.	SIMILAR TO * JEDEC REG NO
CR1	19A103240P1	

* FOR REFERENCE ONLY NOT RECOMMENDED FOR EXACT REPLACEMENT

GP.	R1
1	27K
2	8.2K

Elementary Diagram

RF MULTIPLIER
PL-19C313920-G1

(Drawing No. 19B220567, Rev. 1)

PRINCIPLES OF OPERATION

CRYSTAL CONTROLLED AFC REFERENCE
PL-19E500160-G1 thru -G5

GENERAL

The crystal controlled AFC reference assembly consists of the waveguide, reference oscillator, 360 MHz filter, mixer/multiplier diode, and the IF-discriminator portions of the crystal controlled AFC system. The mixer/multiplier diode is mounted inside the waveguide; the reference oscillator, 360 MHz filter and IF-discriminator subassemblies are contained in shielded enclosures fastened to the waveguide. Transmitter energy is sampled by coupling it into the mixer/multiplier diode which is driven by the reference oscillator and supplies an IF signal to the IF-discriminator where it is, in effect, compared to a 70 MHz reference signal. When the transmitter is on-frequency, the IF signal supplied by the diode is also at 70 MHz, and the output of the discriminator is a dc voltage. If, however, the transmitter frequency drifts, the IF signal supplied by the diode will be either above or below 70 MHz, and when this is compared to the 70 MHz reference signal, the output of the discriminator will be a square wave error voltage whose amplitude is a function of the frequency difference. The error voltage is applied to the AFC amplifier where it is used to change the repeller voltage applied to the klystron so as to correct transmitter frequency.

SPECIFICATIONS

Group Identification

Group 1	Government Band 7.125 to 8.400 GHz
Group 2	Common Carrier 5.925 to 6.425 GHz
Group 3	PSIT Band 6.575 to 6.875 GHz
Group 4	Common Carrier and PSIT Bands 5.925 to 6.875 GHz (25 dB)
Group 5	Common Carrier and PSIT Bands 5.925 to 6.875 GHz (20 dB)

AFC Error Voltage Sensitivity:	40 mV/MHz
Supply Voltage:	-24 Vdc

CIRCUIT DESCRIPTION

The crystal controlled AFC reference assembly consists of three sections of waveguide to which are attached a 360 MHz filter and two shielded enclosures containing the reference oscillator and the IF-discriminator. The description of the circuit configuration is made with reference to Elementary Diagram 19C313543.

The waveguide portion of the assembly contains the frequency monitor and mixer/multiplier functions of the crystal controlled AFC system. A flanged section of waveguide is connected into the main line that carries transmitter energy. Two auxiliary sections are joined to the flanged section by E-plane junctions in which directional coupler slots are cut. Energy thus coupled into the auxiliary sections is 25 dB below that in the main line.

Energy coupled into one of the auxiliary section is directed toward a probe connected to frequency monitor jack J6. Transmitter frequency can be monitored by connecting a suitable instrument to this jack.

Energy coupled into the other auxiliary section is directed through a 0-25 dB attenuator toward diode CR1 located inside the waveguide. Diode CR1 is a hot-carrier diode that is biased by the 360 MHz signal from reference oscillator A2 applied to it through the 360 MHz filter assembly and C1. This signal can be monitored at jack J1 on the shielded enclosure that contains the reference oscillator. Thus biased, the diode multiplies the 360 MHz signal from 17 to 23 times, depending on which of the bands the transmitter operates; it also serves as a converter that supplies a signal whose frequency is the difference between the multiplied reference signal and the sampled transmitter signal to IF-discriminator A3 through C2. When the transmitter is operating on its assigned frequency, this is a 70 MHz signal. Four jacks and a test point are located on the enclosure that contains the IF-discriminator. The 70 MHz reference signal is applied at jack J2, and can be monitored at jack J3; fault sensing output is available at jack J4; AFC error output is available at jack J5 and at C5. Square wave drive is applied at C6, and mixer current can be monitored at TP1. Both the IF-discriminator and the reference oscillator require a -24 Vdc input; it is applied at C4 on the IF-discriminator, and at C3 on the reference oscillator.

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MAINTENANCE

CRYSTAL CONTROLLED AFC UNIT PL-19E500160-G1 THRU -G4

GENERAL

The crystal controlled AFC unit maintenance will include all the testing on the unit that can be accomplished without an RF power source. The subassemblies of the crystal controlled AFC assembly that require testing are the 360 MHz reference oscillator, IF discriminator and the AFC waveguide. Maintenance information in the following paragraphs will include the test equipment required for the tests, electrical characteristics of the crystal controlled AFC and the maintenance procedure. Reference diagrams are listed in figure 1 and provide supplemental information necessary to maintenance personnel.

DIAGRAM	DRAWING NUMBER
Crystal Controlled AFC Assembly	19E500677
Crystal Controlled AFC Elementary	19C313543
IF Discriminator Assembly	19C319097
IF Discriminator Elementary	19R600013
360 MHz Reference Oscillator Assembly	19C319095
360 MHz Reference Oscillator Elementary	19D405917

Figure 1. Reference Diagrams

ELECTRICAL CHARACTERISTICS

The electrical characteristics listed in figure 2 represent the crystal controlled AFC characteristics that must be met for an acceptable test.

TEST EQUIPMENT REQUIRED (or equivalent)

Test equipment required for the maintenance of the crystal controlled AFC unit is listed in figure 3.

The waveguide portion of the assembly contains the frequency monitor and mixer/multiplier functions of the crystal controlled AFC system. A flanged section of waveguide is connected into the main line that carries transmitter energy. Two auxiliary sections are joined to the flanged section by E-plane junctions in which directional coupler slots are cut. Energy thus coupled into the auxiliary sections is 25 dB below that in the main line.

Energy coupled into one of the auxiliary section is directed toward a probe connected to frequency monitor jack J6. Transmitter frequency can be monitored by connecting a suitable instrument to this jack.

Energy coupled into the other auxiliary section is directed through a 0-25 dB attenuator toward diode CR1 located inside the waveguide. Diode CR1 is a hot-carrier diode that is biased by the 360 MHz signal from reference oscillator A2 applied to it through the 360 MHz filter assembly and C1. This signal can be monitored at jack J1 on the shielded enclosure that contains the reference oscillator. Thus biased, the diode multiplies the 360 MHz signal from 17 to 23 times, depending on which of the bands the transmitter operates; it also serves as a converter that supplies a signal whose frequency is the difference between the multiplied reference signal and the sampled transmitter signal to IF-discriminator A3 through C2. When the transmitter is operating on its assigned frequency, this is a 70 MHz signal. Four jacks and a test point are located on the enclosure that contains the IF-discriminator. The 70 MHz reference signal is applied at jack J2, and can be monitored at jack J3; fault sensing output is available at jack J4; AFC error output is available at jack J5 and at C5. Square wave drive is applied at C6, and mixer current can be monitored at TP1. Both the IF-discriminator and the reference oscillator require a -24 Vdc input; it is applied at C4 on the IF-discriminator, and at C3 on the reference oscillator.

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MAINTENANCE

CRYSTAL CONTROLLED AFC UNIT PL-19E500160-G1 THRU -G4

GENERAL

The crystal controlled AFC unit maintenance will include all the testing on the unit that can be accomplished without an RF power source. The subassemblies of the crystal controlled AFC assembly that require testing are the 360 MHz reference oscillator, IF discriminator and the AFC waveguide. Maintenance information in the following paragraphs will include the test equipment required for the tests, electrical characteristics of the crystal controlled AFC and the maintenance procedure. Reference diagrams are listed in figure 1 and provide supplemental information necessary to maintenance personnel.

DIAGRAM	DRAWING NUMBER
Crystal Controlled AFC Assembly	19E500677
Crystal Controlled AFC Elementary	19C313543
IF Discriminator Assembly	19C319097
IF Discriminator Elementary	19R600013
360 MHz Reference Oscillator Assembly	19C319095
360 MHz Reference Oscillator Elementary	19D405917

Figure 1. Reference Diagrams

ELECTRICAL CHARACTERISTICS

The electrical characteristics listed in figure 2 represent the crystal controlled AFC characteristics that must be met for an acceptable test.

TEST EQUIPMENT REQUIRED (or equivalent)

Test equipment required for the maintenance of the crystal controlled AFC unit is listed in figure 3.

ELECTRICAL CHARACTERISTIC	REQUIREMENT
360 MHz oscillator output	greater than +8 dBm
360 MHz oscillator frequency	9 times the crystal frequency ±1000 Hz. Crystal frequency marked on crystal case
360 MHz filter output current	greater than 3 mA
IF discriminator IF gain	greater than 43 dB
IF frequency response	less than 1 dB; 60 to 80 MHz
IF discriminator linearity	less than 3% from 64 to 76 MHz
Baseband sensitivity	greater than 35 mV/MHz

Figure 2. Crystal Controlled AFC Electrical Characteristics

TEST EQUIPMENT	MODEL	REQUIREMENT
RF Voltmeter (Hewlett-Packard)	HP411A	
DC Ammeter (Triplett)	630	
Electronic Counter (Hewlett-Packard)	5246L	
Sweep Generator (Kay Electric)	159B	Must be modified. See figure 8.
Head (Kay Electric)	PM7660	Markers at 60 MHz, 70 MHz, 80 MHz
Distortion Meter (Siemens)	VZM-83	
Oscilloscope (Hewlett-Packard)	130B	
Test Set (General Electric)	4UZ24A1	

Figure 3. Test Equipment Required (Sh. 1 of 2)

TEST EQUIPMENT	MODEL	REQUIREMENT
Attenuator (Telonic)	TC50-A	50 ohms
Power Supply (Hewlett-Packard)	723A	-24 V, 0.5 mA
Tee Probe Tip (Hewlett-Packard)	11024A	
External Detector		See figure 10
Termination (Hewlett-Packard)	908A	

Figure 3. Test Equipment Required (Sh. 2 of 2)

MAINTENANCE PROCEDURE

The maintenance procedures consist of tuning for and testing of characteristics listed in figure 2. Supplemental illustrations are provided at the end of the procedure and are referenced throughout the procedure where applicable.

360-MHz REFERENCE OSCILLATOR AND FILTER TUNING

(1) Connect test equipment as per figure 4.

(2) Remove component access cover of the 360 MHz oscillator. Connect R20 and R21 directly to connector J1.

(3) Connect -24 Vdc to terminal A1-C4 and the assembly (common).

(4) Observe electronics counter for a frequency 9 times the crystal frequency ±1000 Hz and RF voltmeter for amplitude greater than +8 dBm.

(5) If tuning is required adjust L1 for oscillation indication on the voltmeter, it may be necessary to place a loop on the RF test proble cable within 1/2 inch of coils L2 and L3. Adjust L2, L3, C10, C15, C16, C20, and C21 for a peak output, adjusting components in the order listed.

(6) When peak output is attained, frequency may be off slightly, exact frequency can be obtained by readjusting L1.

(7) Reconnect components R20, R21, and C1 to their original configuration.

(8) Disconnect test equipment of figure 4.

(9) Connect test equipment as shown in figure 5.

(10) Diode current will be observed on VOM when filter is tuned near its resonance.

(11) The filter turning screws must be run in close together, relative length between screws should not exceed 1/4 inch. Peak diode current amplitude with the tuning screws.

(12) Remove IF discriminator component access cover and adjust potentiometer R2 for a maximum indication on VOM. This should be greater than 3 mA.

IF AMPLIFIER AND DISCRIMINATOR TEST AND TUNING

(1) Disconnect test equipment of figure 5 and connect test equipment as shown in figure 6.

(2) Adjust Kay sweep generator for output of -48 dBm with markers set for 60 MHz, 70 MHz, (center) and 90 MHz.

(3) Response curve ripple on oscilloscope between 60 MHz to 80 MHz should be less than 1 db.

(4) Ripple of response curve can be adjusted with components C5, L3, and L4 of IF discriminator board (A3).

(5) Set the Kay sweep output level to 125 mV into 50 ohms, measured with a 411A. Apply this level to the input and insert 42 dB in the sweep attenuator.

(6) Observe RF voltmeter at the output for 125 mV ±2 dB.

(7) Disconnect test equipment as per instruction 1 and connect test equipment as shown in figure 7.

(8) Adjust test equipment to measure 3% linearity of IF discriminator between 63 MHz and 77 MHz with a center frequency at 70 MHz.

(9) Linearity adjustment is accomplished by adjusting components L10, C41 (low side) and L11, C42 (high side) of the IF discriminator boards (A3) if linearity is greater than 3%.

(10) Disconnect test equipment.

(11) Connect test equipment as shown in figure 9.

(12) Connect GE test set to J2 and adjust for 65 to 75 MHz deviation.

(13) Adjust scope to measure 350 mvpp or greater square wave.

(14) If any of the checks fail to meet the requirements specified, check individual units as per the circuit board checkout.

(15) Disconnect test equipment from unit and install into transmitter. See transmitter maintenance replacement procedures in chapter 5.

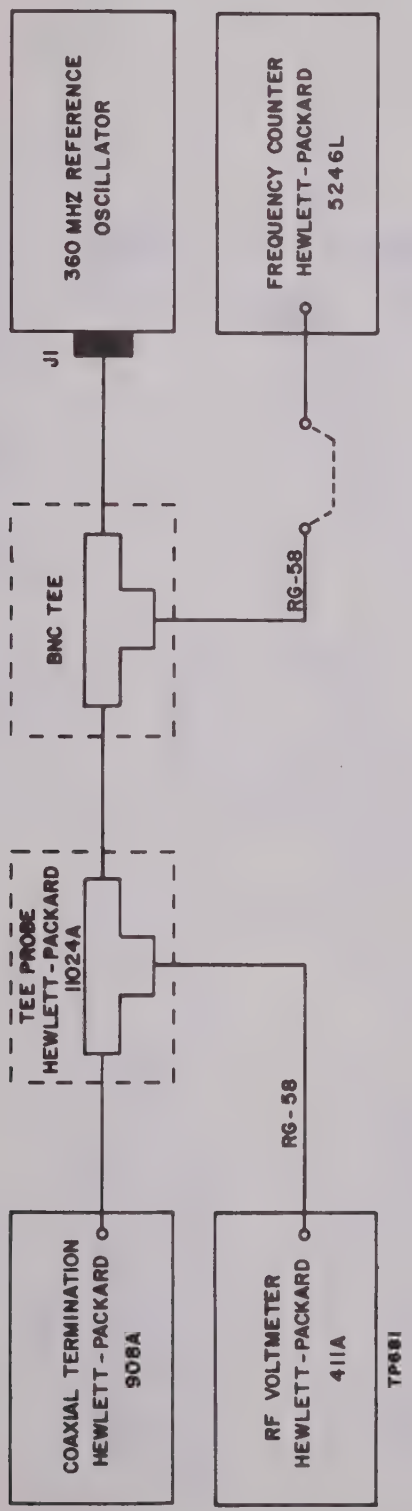

Figure 4. 360 MHz Reference Oscillator Test Setup

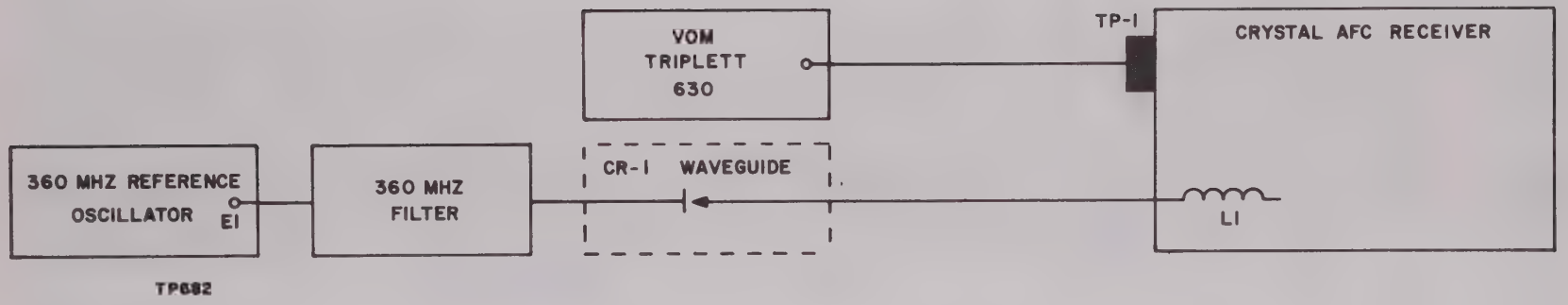

Figure 5. 360 MHz Filter Tuning and Diode Current Test Setup

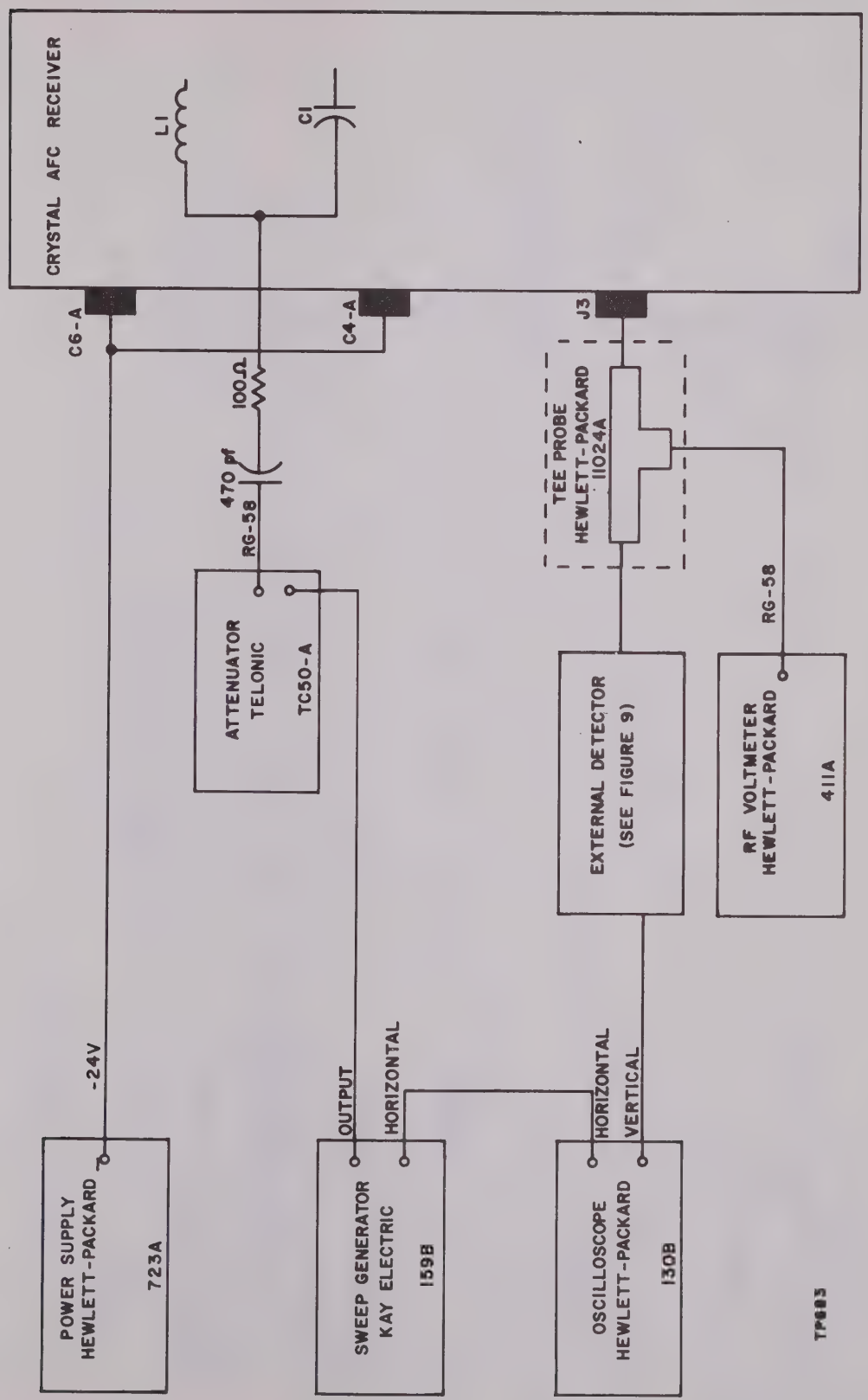

Figure 6. IF Amplifier Tuning Test Setup

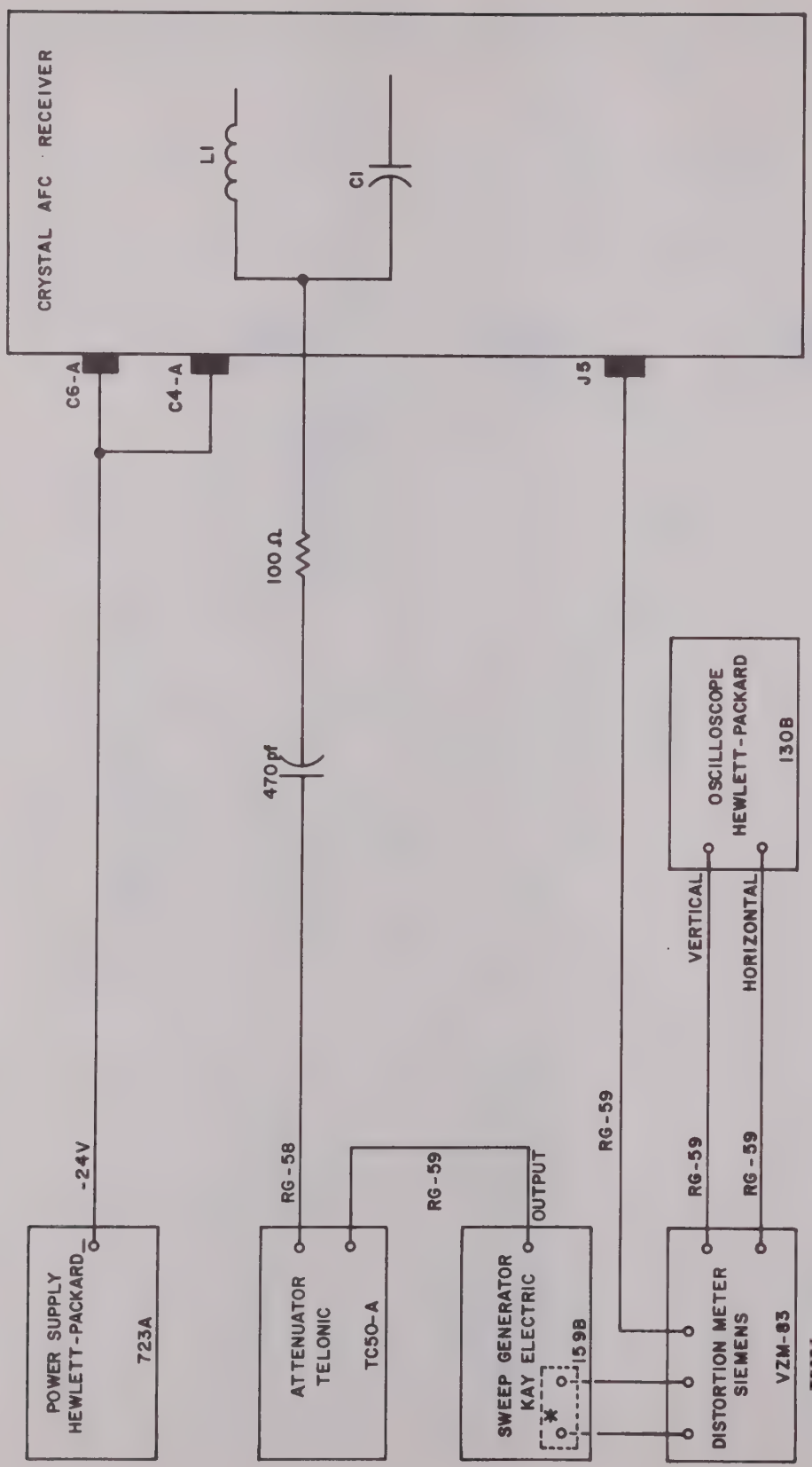

Figure 7. IF Discriminator Linearity Test Setup

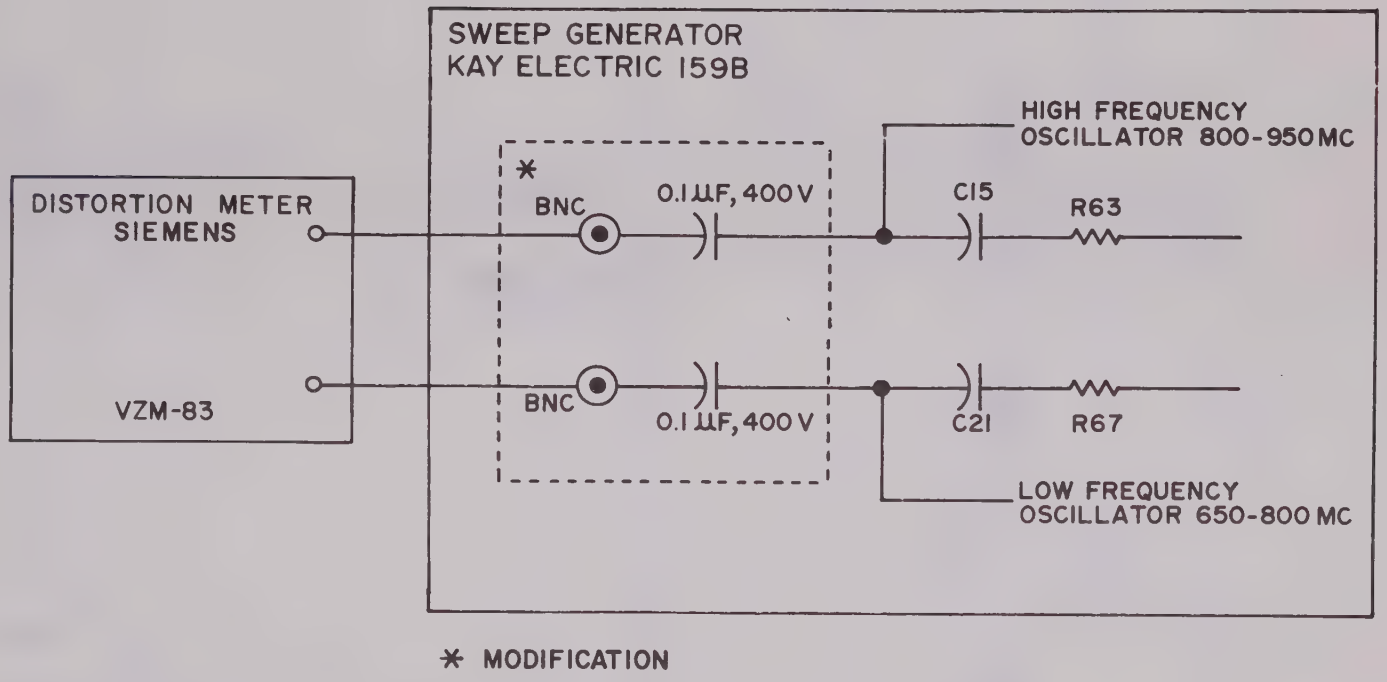

Figure 8. Sweep Generator Modification

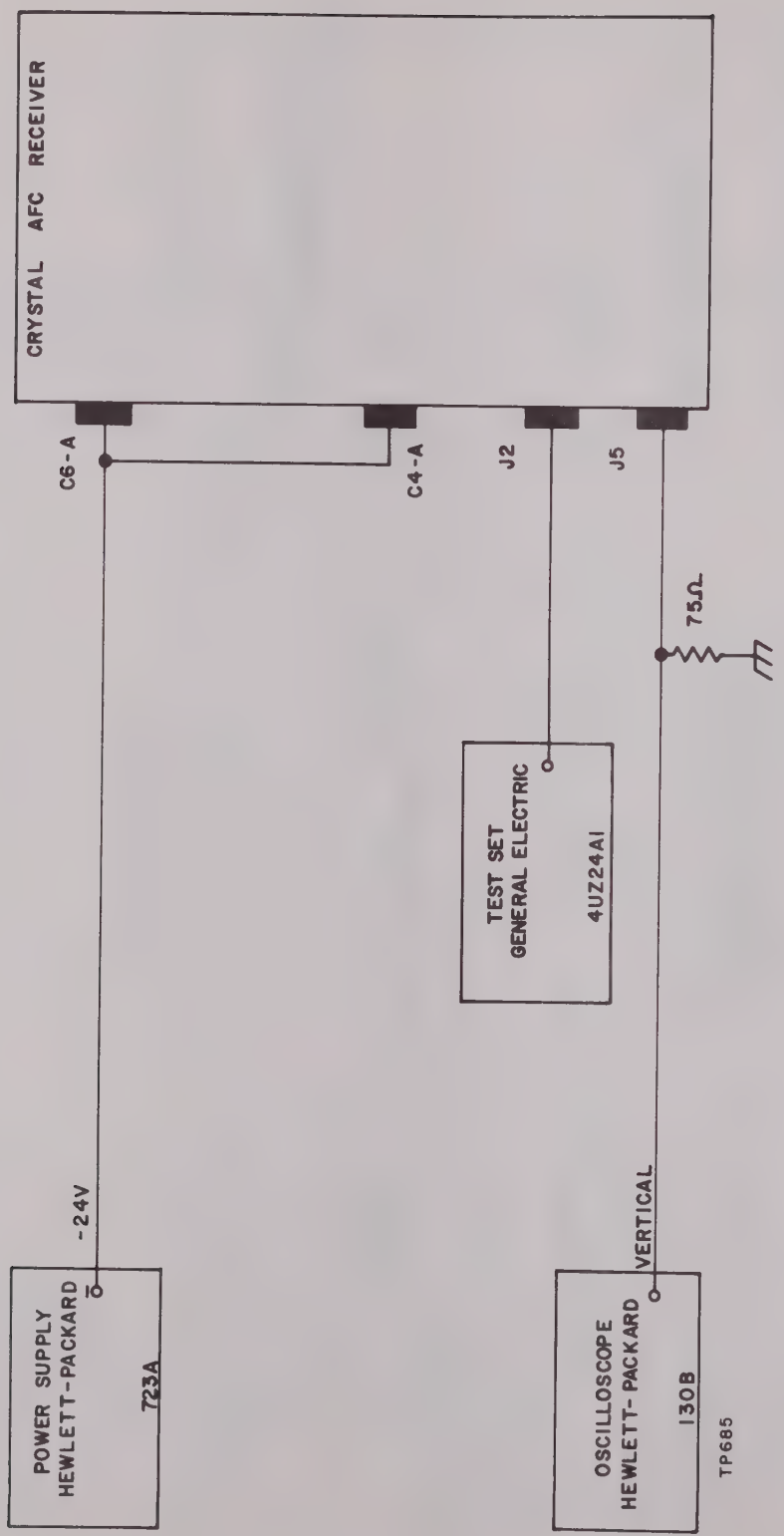

Figure 9. Deviation Calibration Test Setup

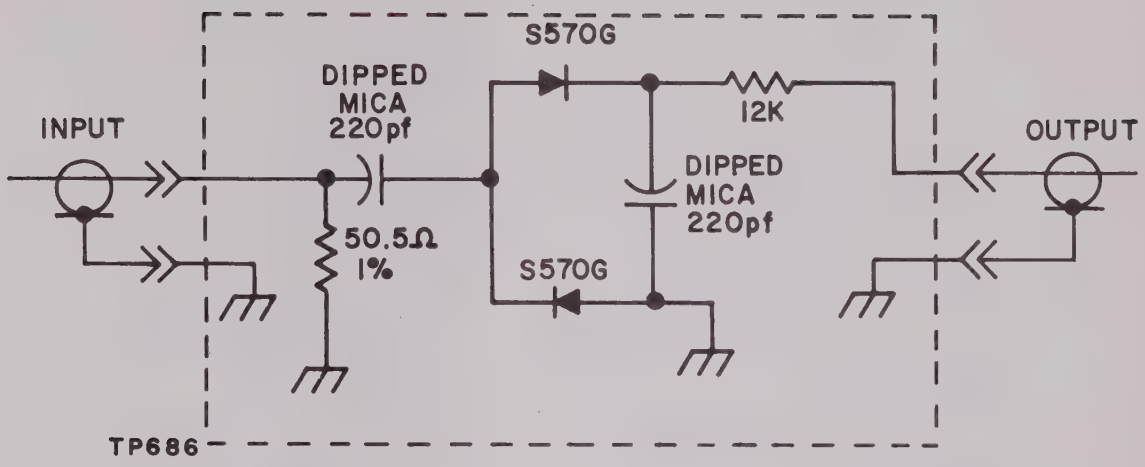

Figure 10. External Detector Schematic Diagram

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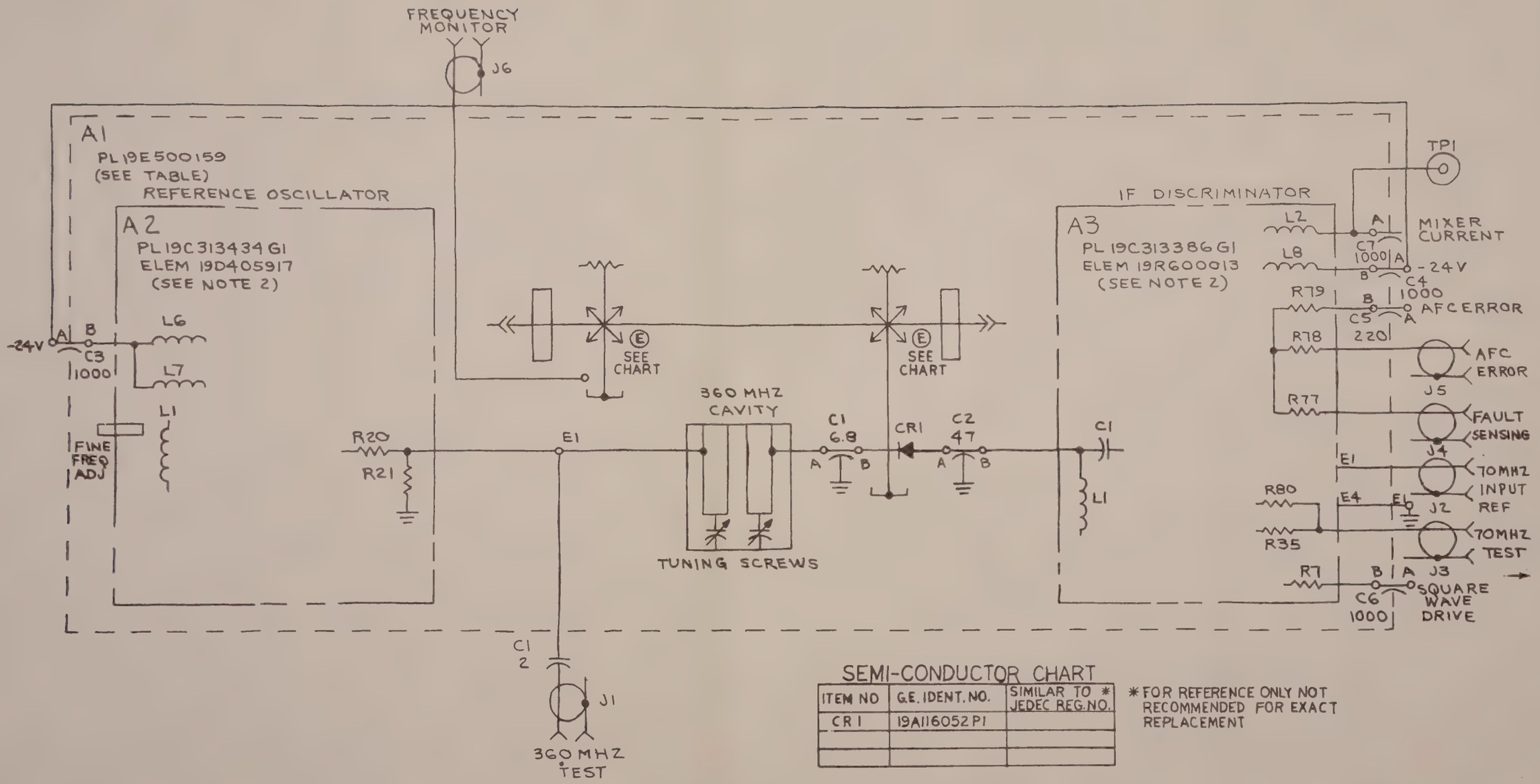


SEMI-CONDUCTOR CHART

ITEM NO	G.E. IDENT. NO.	SIMILAR TO * JEDEC REG. NO.
CR1	19A116052P1	

*FOR REFERENCE ONLY NOT RECOMMENDED FOR EXACT REPLACEMENT

PL19E500160 GP IDENTIFICATION

GP	APPLICATION		A1	COUPLING
1	GOVT BAND	7.125-8.400 GHZ	PL19E500159G1	25 dB
2	COMMON CARRIER	5.925-6.425 GHZ	PL19E500159G2	25 dB
3	PSIT	6.575-6.875GHZ	PL19E500159G3	25 dB
4	CC & PSIT	5.925-6.875GHZ	PL19E500159G4	25 dB
5	CC AND PSIT	5.925-6.875 GHZ	PL19E500159 G5	20 dB

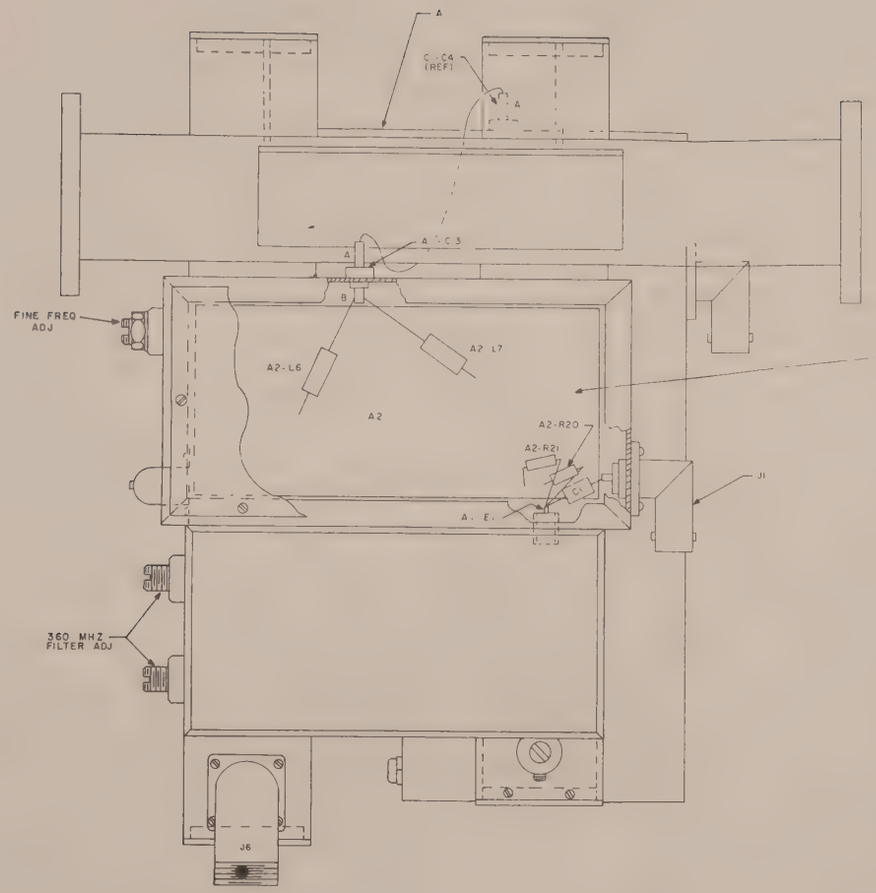
NOTES

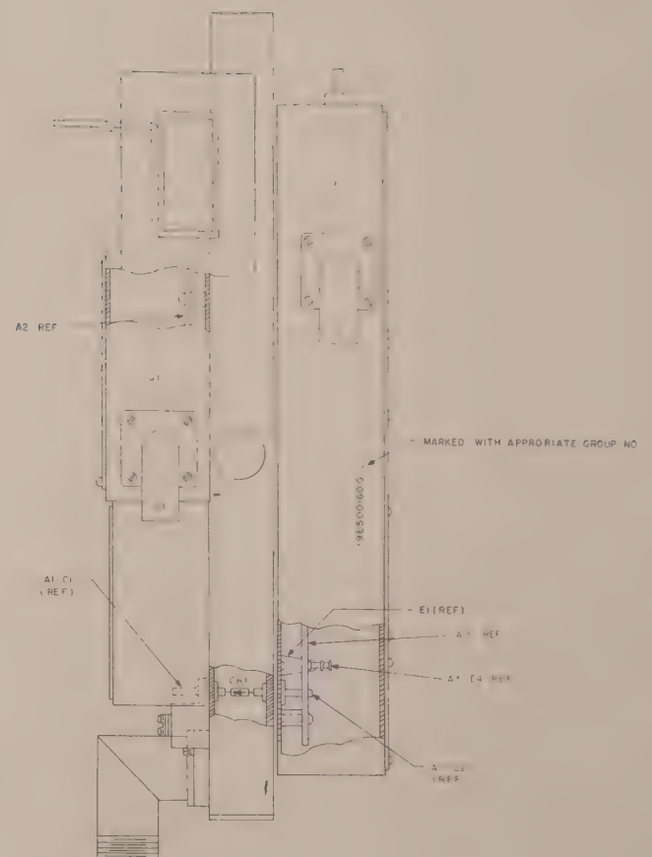
1. ALL RESISTORS ARE 1/2 WATT UNLESS OTHERWISE SPECIFIED AND RESISTOR VALUES IN OHMS UNLESS FOLLOWED BY K=1000 OHMS OR MEG=1,000,000 OHMS. CAPACITOR VALUES IN PICOFARADS (EQUAL TO MICROMICROFARADS) UNLESS FOLLOWED BY UF=MICROFARADS. INDUCTANCE VALUES IN MICROHENRYS UNLESS FOLLOWED BY MH=MILLIHENRYS OR H=HENRYS.
2. COMPONENTS SHOWN ON THIS BOARD FOR REFERENCE ONLY.

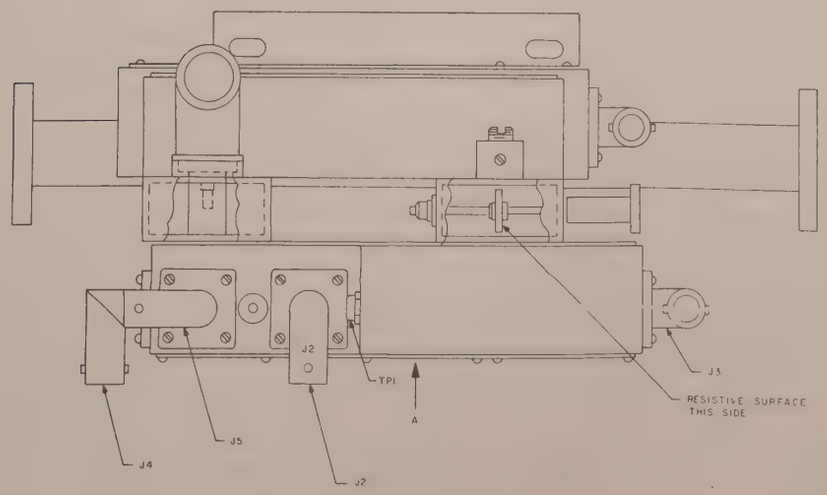
Elementary Diagram

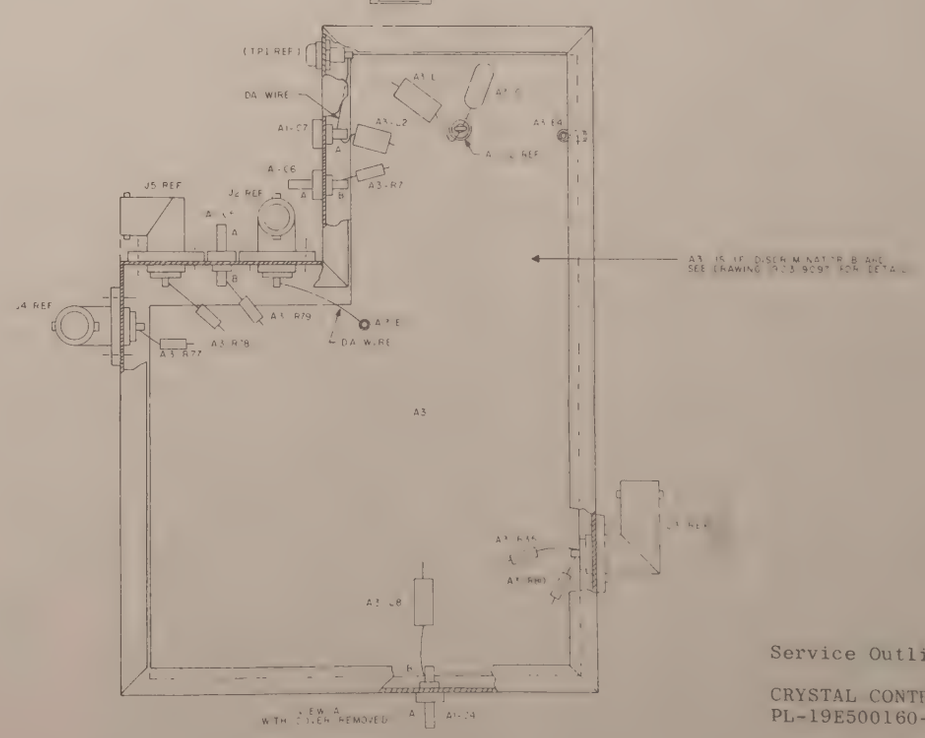
CRYSTAL CONTROLLED AFC
PL-19E500160-G1 thru G4

(Drawing No. 19C313543, Rev. 1)









Service Outline

CRYSTAL CONTROLLED AFC
PL-19E500160-G1 thru G4

(Drawing No. 19E500677, Rev. 1)

PRODUCTION CHANGE SHEET

CRYSTAL CONTROLLED AFC
PL-19E500160-G1 thru -G4

PL-19E500160-G1 thru -G4, REV. A

The following changes were made to 360 MHz oscillator board A2: capacitor C12 and inductor L5 were deleted, and the values of resistors R13 and R18 were changed.

PARTS LIST CHANGES

Symbol	GE Part No.	Description
Delete:		
C12	7489162-P23	Silver mica: 68 pf ±5% 500 VDCW; sim to Electro Motive Type DM-15.
L5	7488079-P3	Choke, RF: 0.33 uh ±20%, 0.07 ohms DC res max; sim to Jeffers 4411-3M.
R13 and R18 Changed to:		
R13	3R152-P103J	Composition: 10000 ohms ±5%, 1/4 w.
R18	3R77-P821J	Composition: 820 ohms ±5%, 1/2 w.

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CRYSTAL CONTROLLED AFC
19E500160-G1 thru G4

SYMBOL	G-E PART NO.	DESCRIPTION
A1		WAVEGUIDE ASSEMBLY 19E500159-G1 19E500160-G1 19E500159-G2 19E500160-G2 19E500159-G3 19E500160-G3 19E500159-G4 19E500160-G4
		- - - - - - - - - - CAPACITORS - - - - - - - - -
C1	5493392-P9	Ceramic, stand-off: 6.8 pf +100% -0%, 500 VDCW; sim to Allen-Bradley Type SS5A.
C2	5493392-P3	Ceramic, stand-off: 47 pf +100% -0%, 500 VDCW; sim to Allen-Bradley Type SS5A.
C3 and C4	5493392-P7	Ceramic, stand-off: 1000 pf +100% -0%, 500 VDCW; sim to Allen-Bradley Type SS5A.
C5	5493392-P5	Ceramic, stand-off: 220 pf +100% -0%, 500 VDCW; sim to Allen-Bradley Type SS5A.
C6	5493392-P7	Ceramic, stand-off: 1000 pf +100% -0%, 500 VDCW; sim to Allen-Bradley Type SS5A.
C7	5493392-P107	Ceramic, stand-off: 1000 pf +100% -0%, 500 VDCW; sim to Allen-Bradley Type SS5A.
A2	19C313434-G1	Oscillator Board. Refer to LBI-13933.
A3	19C313386-G1	IF Discriminator. Refer to LBI-13931.
		- - - - - - - - - - CAPACITORS - - - - - - - - -
C1	7130348-P6	Molded, phen: 2.00 pf ±0.100, 500 VDCW, temp coef 0 PPM; sim to Jeffers Type JM-5/32.
		- - - - - - - DIODES AND RECTIFIERS - - - - - - -
CR1	19A116052-P1	Silicon.
		- - - - - - - JACKS AND RECEPTACLES - - - - - - -
J1 thru J5	5495973-P3	Receptacle, right angle. Military Type UG-535/U or sim to ITC5675.
J6	19A102468-G1	Connector, coaxial. (Used in 19E500160-G1 only).
J6	19A102468-G2	Connector, coaxial. (Used in 19E500160-G1 thru G3 only).
		- - - - - - - - - - TEST POINTS - - - - - - - - - -
TP1	5490384-P1	Jack, tip: white nylon; sim to EF Johnson 105-251-1.

*COMPONENTS ADDED, DELETED OR CHANGED BY PRODUCTION CHANGES.

PRINCIPLES OF OPERATION
CRYSTAL CONTROLLED AFC IF-DISCRIMINATOR
PL-19C313386-G1, -G2

1.0 GENERAL

1.0.1 The IF-discriminator amplifies and demodulates, in alternate succession, the IF signal supplied to it by the mixer/multiplier diode located inside the crystal controlled AFC waveguide assembly and a 70 MHz reference signal supplied to it by an auxiliary oscillator. When the transmitter is operating on frequency, the IF signal supplied by the diode is 70 MHz, and the demodulated output is a dc voltage; if transmitter frequency drifts, the IF signal from the diode will be above or below 70 MHz by an amount proportional to the amount of drift, and the demodulated signal will be a squarewave whose amplitude is a function of the amount of drift. This is the AFC error voltage that is applied to the AFC amplifier where it is used to change klystron repeller voltage so as to correct transmitter frequency. The IF-discriminator is constructed on a printed wire board that is mounted in a shielded enclosure provided for it on the crystal controlled AFC waveguide assembly.

1.1 SPECIFICATIONS

AFC Error Voltage Sensitivity:	40 mv/MHz
Supply Voltage:	-24 VDC

1.2 CIRCUIT DESCRIPTION

1.2.1 The IF-discriminator consists of a six-stage IF amplifier, a limiter, a discriminator and a three-stage baseband amplifier. The circuit description is made with reference to Elementary Diagram 19R600013 for the Group 1 unit, or to Elementary Diagram 19R600015 for the Group 2 unit.

1.2.2 IF AMPLIFIER

1.2.2.1 The six-stage IF amplifier consists of transistors Q1 and Q3 through Q7. A diode bias network is connected from input to ground; in the Group 1 unit it is L1, C2, R1 and R2; in the Group 2 unit it is L1, C2 and R1. In both cases, mixer current test point TP1 is connected into the network through L2. Input signal is coupled into stage Q1 by C2.

1.2.2.2 Transistors Q1 and Q3 form the first two amplifier stages. Both stages are common base amplifiers. The first stage is tuned by C5, L3 and L4 to obtain a bandwidth of approximately 20 MHz centered on the 70 MHz IF frequency. Its output is coupled into the second stage by wideband transformer T1. The second stage is a wideband amplifier. Both stages are turned on and off by a squarewave drive signal applied to their biasing network which consists of R4, R5, R10, R11, C4, C11, R7 and transistor Q2. The squarewave drive signal, supplied by the AFC amplifier unit, is applied to the base of Q2 through R7. When the drive signal is negative, Q2 is turned on so the bias

circuit for stages Q1 and Q3 is grounded and both stages are turned on; when the drive signal is at the zero volt level, Q2 is off so the base bias circuit is ungrounded and stages Q1 and Q3 are off. Resistors R81 in stage Q1 and R82 in stage Q3 are used to assure a back bias condition between emitter and base of stages Q1 and Q3 when the drive voltage is at the zero volt level. The output of stage Q3 is coupled into stage Q4 by wideband transformers T2 and T3.

1.2.2.3 Transistors Q4, Q5, Q6 and Q7, all connected in the common base configuration, make up the remaining four stages of the IF amplifier. Base bias is obtained from a two resistor network and an associated bypass capacitor (R16, R17 and C13 for example), and a wide passband is obtained by the use of wideband coupling transformers such as T4 and T5 and stabilizing resistors such as R18 and R23. High frequency stability is obtained by use of the stabilizing impedances supplied by resistors R14, R19, R26 and R31. A 70 MHz reference signal, supplied by an auxiliary oscillator, is connected to terminal E1, and is bridged into the input of stage Q6 by network R24-R25. The oscillator that supplied this signal is turned on and off by the same squarewave signal applied to transistor Q2, the arrangement being such that stages Q1 and Q3 are turned off when the 70 MHz reference signal is turned on. Thus the signal at the output of the IF amplifier is alternately the signal from the mixer/multiplier diode applied to stage Q1 and the 70 MHz reference signal applied at terminal E1. A 70 MHz test circuit is connected to the collector of stage Q7. The IF amplifier is tuned with jumper E2-E3 removed and terminal E2 connected directly to jack J3 on the chassis. Once tuning is accomplished, the jumper is replaced and a signal that may be used for level monitoring purposes only is provided at jack J3 by connecting it to the divider formed by resistors R35 and R80. Jumper E2-E3 connects the output of the IF amplifier into the limiter circuit.

1.2.3 LIMITER

1.2.3.1 The limiter circuit consists of two sets of limiter diodes, three common base amplifiers and a common collector amplifier. The output of the IF amplifier is connected into limiter diodes CR1 and CR2 whose bias current is determined by resistors R36, R37 and R38. Signal from the limiter diodes is coupled into common base stage Q8 by wideband transformers T10 and T11. The output of Q8, taken through a low pass matching filter consisting of C28, L9 and R44, is coupled into stage Q9 by T12. Stage Q9 drives the second set of limiter diodes, CR3 and CR4, whose bias current is determined by resistors R50, R51 and R52. The limited IF signal is then amplified by common base stage Q10 which in turn drives common collector stage Q11. Signal from the output of Q11 is applied to the discriminator circuit.

1.2.4 DISCRIMINATOR

1.2.4.1 The discriminator circuit used is the tuned high, tuned low configuration. The low side consists of L10, C41, CR5, C43 and R64, while the high side consists of L11, C42, CR6, C44, and R65. Bandwidth is approximately 40 MHz, and the circuit is tuned for 3% linearity from 63 MHz to 77 MHz. The demodulated signal is a dc voltage when the transmitter is on frequency and there is no difference be-

tween the 70 MHz signal from the mixer/multiplier diode and that from the 70 MHz reference oscillator. If transmitter frequency drifts, there will be a difference between these two signals, and the demolated output will be a squarewave whose amplitude is proportional to the amount of drift. Discriminator output is applied to the baseband amplifier.

1.2.5 BASEBAND AMPLIFIER

1.2.5.1 The baseband amplifier is basically a dc doublet amplifier with an emitter follower output. Stages Q12 and Q13 form the doublet and Q14 is the emitter follower. Linearity and stability (both dc and ac) are achieved, and amplifier gain is set by degenerative feedback from output stage Q14 to input stage Q12 through resistor R73. Stage Q14 also serves as a distribution amplifier by providing two 75-ohm outputs and a 10K-ohm output. The two 75-ohm outputs are the AFC error output taken through R78 and J5 on the chassis, and the fault sensing output taken through R77 and J4 on the chassis. The one 10K-ohm output, taken through R79, is made available at terminal C5A on the chassis; this output is used for the (optional) AFC alarm unit.

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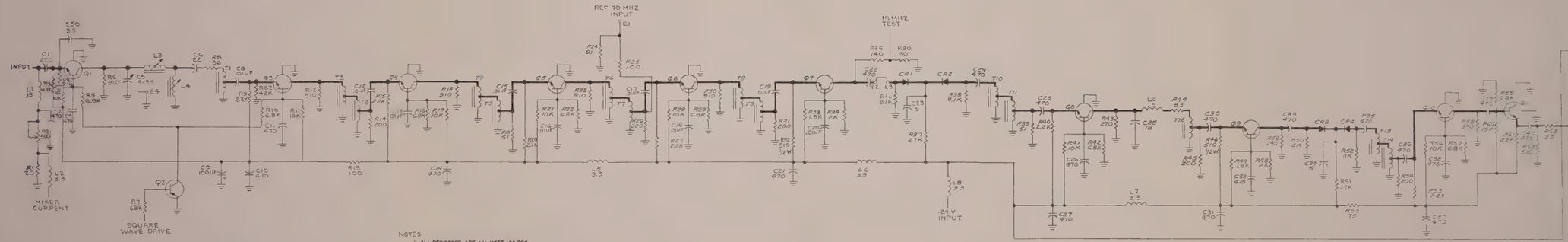


SEMI-CONDUCTOR CHART

ITEM NO	GE IDENT NO	SIMILAR TO * JEDEC REGNO
CR1,2,3&4	19A116052P1	——
CR5&6	54B226292P2	1-570G
CR7&8	19A115260P1	1SC-753
Q1,3,4,5,6, 8,10&11	19A115440P2	——
Q2	19A115768P1	2N3702
Q7&Q9	19A115329P2	——
Q12	19A115862P1	2N3508
Q13	19A115910P1	2N3614
Q14	19A115300P1	2N3053

* FOR REFERENCE ONLY NOT RECOMMENDED FOR EXACT REPLACEMENT.

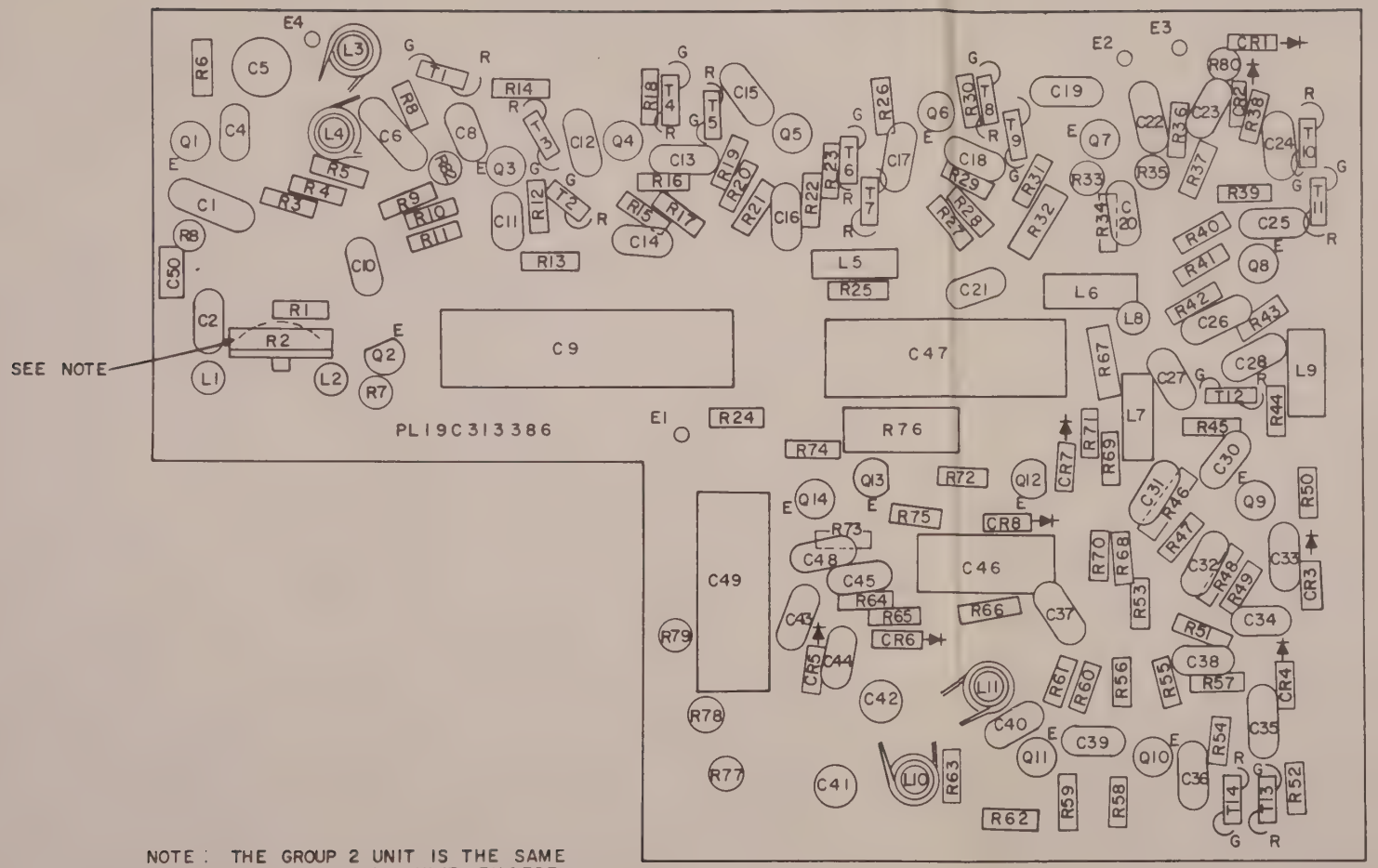
NOTES

1. ALL RESISTORS ARE 1/4 WATT UNLESS OTHERWISE SPECIFIED AND RESISTOR VALUES IN OHMS UNLESS FOLLOWED BY K=1000 OHMS OR MEG = 1,000,000 OHMS. CAPACITOR VALUES IN PICOFARADS (EQUAL TO MICROMICROFARADS) UNLESS FOLLOWED BY UF= MICROFARADS. INDUCTANCE VALUES IN MICROHENRYS UNLESS FOLLOWED BY MH= MILLIHENRYS OR H=HENRYS

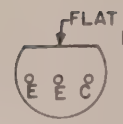
Elementary Diagram

IF-DISCRIMINATOR
PL-19C313386-G1

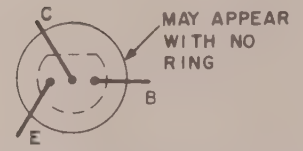
(Drawing No. 19R600013, Rev. 0)



NOTE : THE GROUP 2 UNIT IS THE SAME AS THE GROUP 1 UNIT EXCEPT THAT R2 IS OMITTED AND A BUS WIRE IS CONNECTED AS SHOWN.

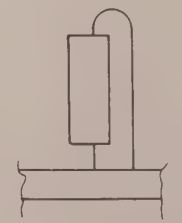


LEAD IDENT. FOR Q12 & Q13



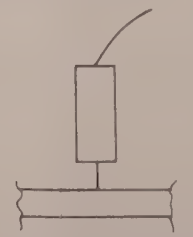
LEAD IDENTIFICATION FOR Q2, Q7, Q9 & Q14

LEAD IDENTIFICATION FOR Q1, Q3, Q4, Q5, Q6, Q8, Q10 & Q11



MOUNTING FOR L3, 4, 10 & 11

FORMING & MOUNTING OF R33, R81, & R82



FORMING & MOUNTING OF L2, L8, R7, R77, R78, R79, R80, & R35

Service Outline

IF-DISCRIMINATOR BOARD
PL-19C313386-G1 & G2

(Drawing No. 19C319097, Rev. 0)

PARTS LIST

IF-DISCRIMINATOR BOARD
19C313386-G1, G2

SYMBOL	G-E PART NO.	DESCRIPTION
		- - - - - - - - - CAPACITORS - - - - - - - - -
C1	7489162-P35	Silver mica: 220 pf ±5%, 500 VDCW; sim to Electro Motive Type DM-15.
C2	5494481-P107	Ceramic disc: 470 pf ±20%, 1000 VDCW; sim to RMC Type JF Discap.
C4	5494481-P107	Ceramic disc: 470 pf ±20%, 1000 VDCW; sim to RMC Type JF Discap.
C5	19C301246-P12	Variable, ceramic: 9.0 to 35 pf; sim to Erie Style 538.
C6	5496219-P47	Ceramic disc: 22 pf ±5%, 500 VDCW, temp coef 0 PPM.
C8	7491827-P2	Ceramic disc: .01 µf +80% -30%, 50 VDCW; sim to Sprague 19C180.
C9	19A115680-P5	Electrolytic: 100 µf +150% -10%, 25 VDCW; sim to Mallory Type TT.
C10 and C11	5494481-P107	Ceramic disc: 470 pf ±20%, 1000 VDCW; sim to RMC Type JF Discap.
C12 and C13	7491827-P2	Ceramic disc: .01 µf +80% -30%, 50 VDCW; sim to Sprague 19C180.
C14	5494481-P107	Ceramic disc: 470 pf ±20%, 1000 VDCW; sim to RMC Type JF Discap.
C15 thru C20	7491827-P2	Ceramic disc: .01 µf +80% -30%, 50 VDCW; sim to Sprague 19C180.
C21 and C22	5494481-P107	Ceramic disc: 470 pf ±20%, 1000 VDCW; sim to RMC Type JF Discap.
C23	5496219-P36	Ceramic disc: 5.0 pf ±5%, 500 VDCW, temp coef 0 PPM.
C24 thru C27	5494481-P107	Ceramic disc: 470 pf ±20%, 1000 VDCW; sim to RMC Type JF Discap.
C28	5496219-P45	Ceramic disc: 18 pf ±5%, 500 VDCW, temp coef 0 PPM.
C30 thru C33	5494481-P107	Ceramic disc: 470 pf ±20%, 1000 VDCW; sim to RMC Type JF Discap.
C34	5496219-P36	Ceramic disc: 5.0 pf ±5%, 500 VDCW, temp coef 0 PPM.
C35 thru C40	5494481-P107	Ceramic disc: 470 pf ±20%, 1000 VDCW; sim to RMC Type JF Discap.
C41	19C301246-P14	Variable, ceramic: 15.0 to 60 pf; sim to Erie Style 538.
C42	19C301246-P2	Variable, ceramic: 2.0 to 8 pf; sim to Erie Style 538.
C43 and C44	5496219-P41	Ceramic disc: 10 pf ±5%, 500 VDCW, temp coef 0 PPM.
C45	5496219-P38	Ceramic disc: 7.0 pf ±5%, 500 VDCW, temp coef 0 PPM.
C46	19A115680-P3	Electrolytic: 20 µf +150% -10%, 25 VDCW; sim to Mallory Type TT.
C47	19A115680-P11	Electrolytic: 50 µf +150% -10%, 35 VDCW; sim to Mallory Type TT.
C48	5496219-P34	Ceramic disc: 3.0 pf ±5%, 500 VDCW, temp coef 0 PPM.
C49	19A115680-P7	Electrolytic: 100 µf +150% -10%, 15 VDCW; sim to Mallory Type TT.
C50	5491601-P30	Phenolic: 3.3 pf ±10%, 500 VDCW.
		- - - - - - - DIODES AND RECTIFIERS - - - - - - -
CR1 thru CR4	19A116052-P1	Silicon.
CR5 and CR6	5492262-P2	Germanium; sim to Transitron S-570G.
CR7 and CR8	19A115250-P1	Silicon.
		- - - - - - - - - TEST POINTS - - - - - - - - -
E1 thru E4	19A115296-P1	Terminal, standoff; sim to Cambridge Thermionic X1558-BB.
		- - - - - - - - - INDUCTORS - - - - - - - - -
L1	7488079-P5	Choke, RF: 0.68 µh ±10%, 0.15 ohms DC res max; sim to Jeffers 4411-5. (Used in G2 only).
L1	7488079-P1	Choke, RF: 0.15 µh ±20%, 0.03 ohms DC res max; sim to Jeffers 4411-1. (Used in G1 only).
L2	7488079-P10	Choke, RF: 3.30 µh ±10%, 0.15 ohms DC res max; sim to Jeffers 4421-1.
L3	19B208961-G3 19B200497-P2	Coil. Includes: Core.
L4	19B208961-G10 19B200497-P2	Coil. Includes: Core.
L5 thru L8	7488079-P10	Choke, RF: 3.30 µh ±10%, 0.15 ohms DC res max; sim to Jeffers 4421-1.
L9	7488079-P1	Choke, RF: 0.15 µh ±20%, 0.03 ohms DC res max; sim to Jeffers 4411-1.
L10	19B208961-G9 19B200497-P2	Coil. Includes: Core.
L11	19B208961-G4 19B200497-P2	Coil. Includes: Core.
		- - - - - - - - - TRANSISTORS - - - - - - - - -
Q1	19A115440-P1	Silicon, NPN.
Q2	19A115768-P1	Silicon, PNP; sim to Type 2N3702.
Q3 thru Q6	19A115440-P1	Silicon, NPN.
Q7	19A115329-P1	Silicon, NPN.
Q8	19A115440-P1	Silicon, NPN.
Q9	19A115329-P1	Silicon, NPN.
Q10 and Q11	19A115440-P1	Silicon, NPN.
Q12	19A115852-P1	Silicon, PNP; sim to Type 2N3906.
Q13	19A115910-P1	Silicon, NPN; sim to Type 2N3904.
Q14	19A115300-P1	Silicon, NPN; sim to Type 2N3053.
		- - - - - - - - - RESISTORS - - - - - - - - -
R1	3R152-P200J	Composition: 20 ohms ±5%, 1/4 w.
R2	19B209358-P102	Variable, carbon film: approx 25 to 500 ohms ±10%, 0.2 w; sim to CTS Type X-201. (Used in G1 only).
R3	3R152-P472J	Composition: 4700 ohms ±5%, 1/4 w.
R4	3R152-P103J	Composition: 10,000 ohms ±5%, 1/4 w.
R5	3R152-P682J	Composition: 6800 ohms ±5%, 1/4 w.
R6	3R152-P911J	Composition: 910 ohms ±5%, 1/4 w.
R7	3R152-P682J	Composition: 6800 ohms ±5%, 1/4 w.
R8	3R152-P360J	Composition: 36 ohms ±5%, 1/4 w.
R9	3R152-P222J	Composition: 2200 ohms ±5%, 1/4 w.
R10	3R152-P682J	Composition: 6800 ohms ±5%, 1/4 w.
R11	3R152-P103J	Composition: 10,000 ohms ±5%, 1/4 w.
R12	3R152-P911J	Composition: 910 ohms ±5%, 1/4 w.

*COMPONENTS ADDED, DELETED OR CHANGED BY PRODUCTION CHANGES.

SYMBOL	G-E PART NO	DESCRIPTION
R13	3R152-P101J	Composition: 100 ohms ±5%, 1/4 w.
R14	3R152-P201J	Composition: 200 ohms ±5%, 1/4 w.
R15	3R152-P222J	Composition: 2200 ohms ±5%, 1/4 w.
R16	3R152-P682J	Composition: 6800 ohms ±5%, 1/4 w.
R17	3R152-P103J	Composition: 10,000 ohms ±5%, 1/4 w.
R18	3R152-P911J	Composition: 910 ohms ±5%, 1/4 w.
R19	3R152-P510J	Composition: 51 ohms ±5%, 1/4 w.
R20	3R152-P222J	Composition: 2200 ohms ±5%, 1/4 w.
R21	3R152-P103J	Composition: 10,000 ohms ±5%, 1/4 w.
R22	3R152-P682J	Composition: 6800 ohms ±5%, 1/4 w.
R23	3R152-P911J	Composition: 910 ohms ±5%, 1/4 w.
R24	3R152-P910J	Composition: 91 ohms ±5%, 1/4 w.
R25	3R152-P101J	Composition: 100 ohms ±5%, 1/4 w.
R26	3R152-P201J	Composition: 200 ohms ±5%, 1/4 w.
R27	3R152-P222J	Composition: 2200 ohms ±5%, 1/4 w.
R28	3R152-P103J	Composition: 10,000 ohms ±5%, 1/4 w.
R29	3R152-P682J	Composition: 6800 ohms ±5%, 1/4 w.
R30	3R152-P911J	Composition: 910 ohms ±5%, 1/4 w.
R31	3R152-P201J	Composition: 200 ohms ±5%, 1/4 w.
R32	3R77-P511J	Composition: 510 ohms ±5%, 1/2 w.
R33	3R152-P182J	Composition: 1800 ohms ±5%, 1/4 w.
R34	3R152-P202J	Composition: 2000 ohms ±5%, 1/4 w.
R35	3R152-P241J	Composition: 240 ohms ±5%, 1/4 w.
R36	3R152-P912J	Composition: 9100 ohms ±5%, 1/4 w.
R37	3R152-P273J	Composition: 27,000 ohms ±5%, 1/4 w.
r38	3R152-P912J	Composition: 9100 ohms ±5%, 1/4 w.
R39	3R152-P510J	Composition: 51 ohms ±5%, 1/4 w.
R40	3R152-P222J	Composition: 2200 ohms ±5%, 1/4 w.
R41	3R152-P103J	Composition: 10,000 ohms ±5%, 1/4 w.
R42	3R152-P682J	Composition: 6800 ohms ±5%, 1/4 w.
R43	3R152-P271J	Composition: 270 ohms ±5%, 1/4 w.
R44	3R152-P330J	Composition: 33 ohms ±5%, 1/4 w.
R45	3R152-P201J	Composition: 200 ohms ±5%, 1/4 w.
R46	3R77-P511J	Composition: 510 ohms ±5%, 1/2 w.
R47	3R152-P182J	Composition: 1800 ohms ±5%, 1/4 w.
R48	3R152-P202J	Composition: 2000 ohms ±5%, 1/4 w.
R49	3R152-P241J	Composition: 240 ohms ±5%, 1/4 w.
R50	3R152-P302J	Composition: 3000 ohms ±5%, 1/4 w.
R51	3R152-P273J	Composition: 27,000 ohms ±5%, 1/4 w.
R52	3R152-P302J	Composition: 3000 ohms ±5%, 1/4 w.
R53	3R152-P750J	Composition: 75 ohms ±5%, 1/4 w.
R54	3R152-P201J	Composition: 200 ohms ±5%, 1/4 w.
R55	3R152-P222J	Composition: 2200 ohms ±5%, 1/4 w.
R56	3R152-P103J	Composition: 10,000 ohms ±5%, 1/4 w.
R57	3R152-P682J	Composition: 6800 ohms ±5%, 1/4 w.
R58	3R152-P331J	Composition: 330 ohms ±5%, 1/4 w.
R59	3R152-P682J	Composition: 6800 ohms ±5%, 1/4 w.
R60	3R152-P103J	Composition: 10,000 ohms ±5%, 1/4 w.
R61	3R152-P222J	Composition: 2200 ohms ±5%, 1/4 w.
R62	3R152-P511J	Composition: 510 ohms ±5%, 1/4 w.
R63	3R152-P330J	Composition: 33 ohms ±5%, 1/4 w.
R64 and R65	3R152-P821J	Composition: 820 ohms ±5%, 1/4 w.
R66	3R152-P103J	Composition: 10,000 ohms ±5%, 1/4 w.
R67	3R77-P101J	Composition: 100 ohms ±5%, 1/2 w.
R68	3R152-P911J	Composition: 910 ohms ±5%, 1/4 w.
R69	3R152-P682J	Composition: 6800 ohms ±5%, 1/4 w.
R70	3R152-P242J	Composition: 2400 ohms ±5%, 1/4 w.
R71	3R152-P751J	Composition: 750 ohms ±5%, 1/4 w.
R72	3R152-P151J	Composition: 150 ohms ±5%, 1/4 w.
R73	3R152-P102J	Composition: 1000 ohms ±5%, 1/4 w.
R74	3R152-P751J	Composition: 750 ohms ±5%, 1/4 w.
R75	3R152-P510J	Composition: 51 ohms ±5%, 1/4 w.
R76	3R78-P361J	Composition: 360 ohms ±5%, 1 w.
R77 and R78	3R152-P750J	Composition: 75 ohms ±5%, 1/4 w.
R79	3R152-P103J	Composition: 10,000 ohms ±5%, 1/4 w.
R80	3R152-P300J	Composition: 30 ohms ±5%, 1/4 w.
R81	3R152-P913J	Composition: 91,000 ohms ±5%, 1/4 w.
R82	3R152-P433J	Composition: 43,000 ohms ±5%, 1/4 w.
		- - - - - - - - - TRANSFORMERS - - - - - - - - -
T1 thru T14	19A101377-G3	Coil. Includes: 5492138-P4 tuning slug.
		- - - - - - - - - MISCELLANEOUS - - - - - - - - -
	4036555-P1	Insulator, washer: nylon. (Used with Q7, Q9, Q14).

PRINCIPLES OF OPERATION

360 MHz REFERENCE OSCILLATOR
PL-19C313434-G1

1.0 GENERAL

1.0.1 The 360 MHz reference oscillator provides the signal used to drive the mixer/multiplier diode located inside the crystal controlled AFC waveguide assembly. It consists of a 40 MHz oscillator and two tripler circuits. The circuit is constructed on a printed wire board that is mounted inside a shielded enclosure provided for it on the crystal controlled AFC waveguide assembly.

1.1 SPECIFICATIONS

Fundamental frequency:	40 MHz
Output frequency:	360 MHz
Output impedance:	50 ohms
Supply voltage:	-24 Vdc

1.2 CIRCUIT DESCRIPTION

1.2.1 The reference oscillator consists of a 40 MHz crystal controlled oscillator and two tripler circuits. These circuits are described with reference to Elementary Diagram 19D405917.

1.2.2 Transistor Q1 is a common emitter stage that serves the dual purpose of oscillator and first tripler. The oscillator portion of the circuit is L1, R1, C1, C2, C3 and Y1. Crystal Y1 is the frequency controlling element of the oscillator that provides the 40 MHz fundamental frequency. The tripler portion is in the collector load circuit comprised of L2, L3, C4 and C6; this is tuned to 120 MHz, the third harmonic of the fundamental. This signal is fed into a buffer stage.

1.2.3 The buffer stage, transistor Q2, is a tuned common base amplifier. Temperature compensation is provided by RT1. The amplifier is tuned to 120 MHz by L4 and C10, and its output is applied to the second tripler stage.

1.2.4 The second tripler, transistor Q3, is a common emitter class "C" amplifier. Its collector load, C5 and L8, is tuned to 360 MHz, the third harmonic of the 120 MHz signal applied to its base, and its output is applied to amplifier Q4 through variable coupling capacitor C16.

1.2.5 Transistor Q4 is a common emitter amplifier with its output tuned to 360 MHz by matching filter C20, C21, L9 and L10. Variable coupling capacitor C16 is used to set the output level, and the output is taken through the pad formed by resistors R19, R20 and R21. This signal is fed through a two-section coaxial filter tuned to 360 MHz, and coupled into the waveguide assembly where it is used to drive the mixer/multiplier diode.

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MAINTENANCE

360 MHZ REFERENCE OSCILLATOR PL-19C313434-G1

3.0 GENERAL

3.0.1 Maintenance procedures for the 360 MHz reference oscillator consist of checking the operation of the circuit for correct output level and frequency. In addition, a voltage analysis table is provided as an aid in troubleshooting the unit. Typical voltage values are given for the collector of each transistor for the normal and fault conditions.

3.0.2 Regulated negative 24 Vdc source voltage is required for the maintenance test.

3.0.3 Refer to drawing 19D405917 for the elementary diagram and to drawing 19C319095 for the service outline. The service outline is used to locate and identify components and pin connections.

3.1 TEST EQUIPMENT REQUIRED (or equivalent)

3.1.1 The test equipment required for maintenance of the 360 MHz reference oscillator is listed in figure 1.

TEST EQUIPMENT	MODEL	REQUIREMENT
Coaxial Termination (Hewlett-Packard)	908A	
Frequency Counter (Hewlett-Packard)	5246L	360 MHz range
Power Supply (Hewlett-Packard)	723A	-24V, 0.5 mA
RF Voltmeter (Hewlett-Packard)	411A	
Tee Probe (Hewlett-Packard)	11024A	

Figure 1. Test Equipment Required

3.2 MAINTENANCE PROCEDURES

3.2.1 TEST PROCEDURES

(1) Remove top covers from 360 MHz reference oscillator.

(2) Connect chassis of 360 MHz reference oscillator to ground strap.

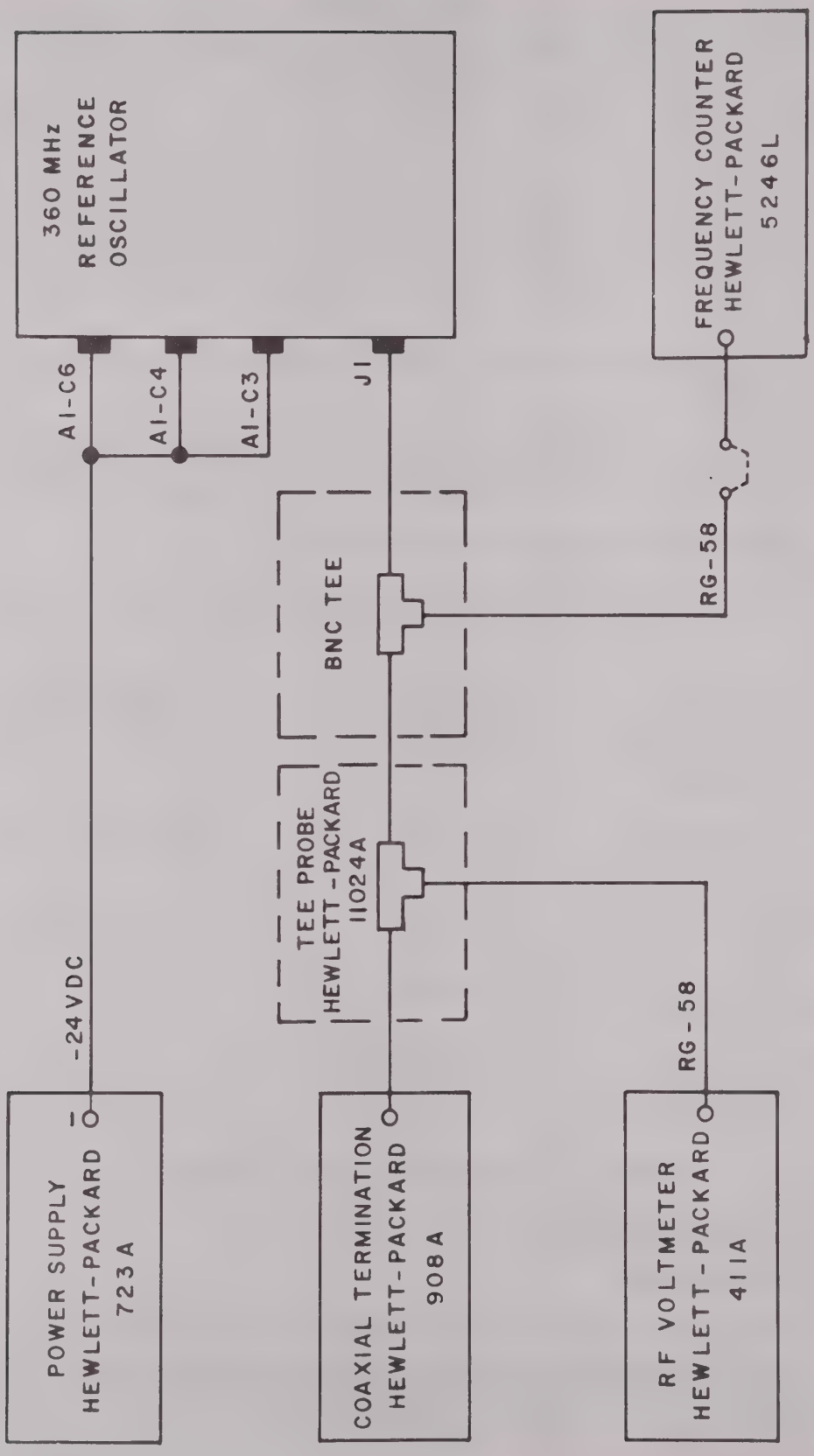

Figure 2. 360 MHz Reference Oscillator Test Setup

(3) Remove end of C1 from J1 of 360 MHz reference oscillator.

(4) Connect R20 and R21 from 360 MHz reference oscillator board directly to J1 of unit.

(5) Mount unit to be tested on test stand.

(6) Connect test equipment as illustrated in figure 2.

(7) Turn -24 Vdc power supply on.

(8) Plug crystal into socket on 360 MHz reference oscillator board.

(9) Adjust RF voltmeter RANGE switch until reading is obtained on its meter. If reading is not obtained on lowest range (-30 dBm), adjust L1 on board A2 until peak reading is indicated on RF voltmeter.

(10) Adjust L2, L3, C10, C15, C16, C20 and C21 (in this order) on board A2 for peak reading on RF voltmeter. Range of RF voltmeter must be increased as tuning progresses.

(11) Repeak L1, L2, L3, C10, C15, C20 and C21 on board A2. RF voltmeter must read +8 dBm or greater.

(12) Slowly adjust L1 on board A2 until frequency counter displays frequency of nine times crystal frequency ±1000 Hz.

(13) Remove cable from J1 of unit.

(14) Remove R20 and R21 from J1 of unit and solder them to E1 of unit.

(15) Solder C1 back to J1 of unit.

3.2.2 VOLTAGE MEASUREMENTS

NOTE

Voltage readings listed in figure 3 are typical. All voltages are measured with respect to ground.

TRANSISTOR	EMITTER	BASE	COLLECTOR
Q1	-6.8	-6.3	0
Q2	-12.6	-11.5	0
Q3	-9.1	-24	0
Q4	-8.8	-8	0

Figure 3. Voltage Troubleshooting Chart

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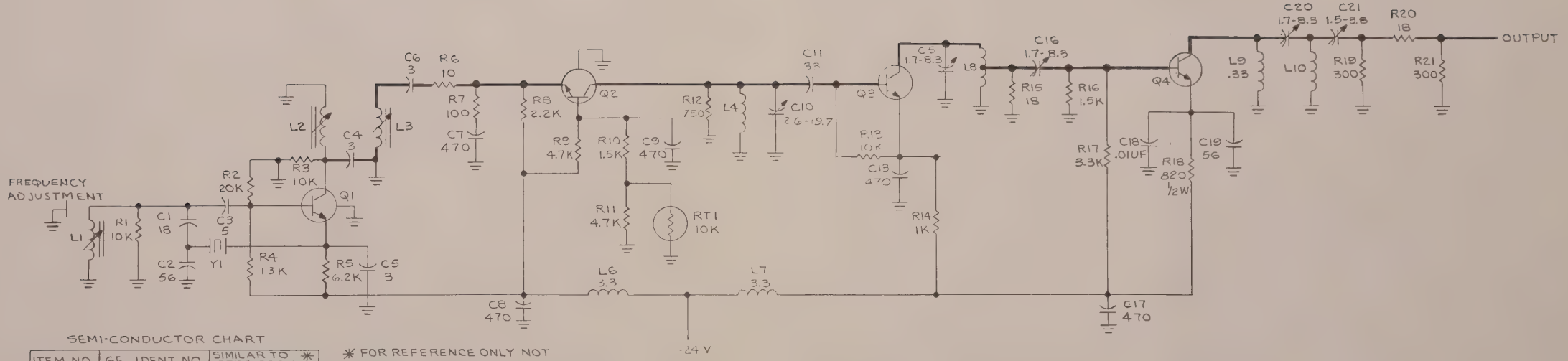


SEMI-CONDUCTOR CHART

ITEM NO	GE IDENT NO	SIMILAR TO JEDEC REG NO *
Q1 & Q2	19A115440P1	——
Q3	19A115810P1	2N3866
Q4	19A115329P1	——

* FOR REFERENCE ONLY NOT RECOMMENDED FOR EXACT REPLACEMENT.

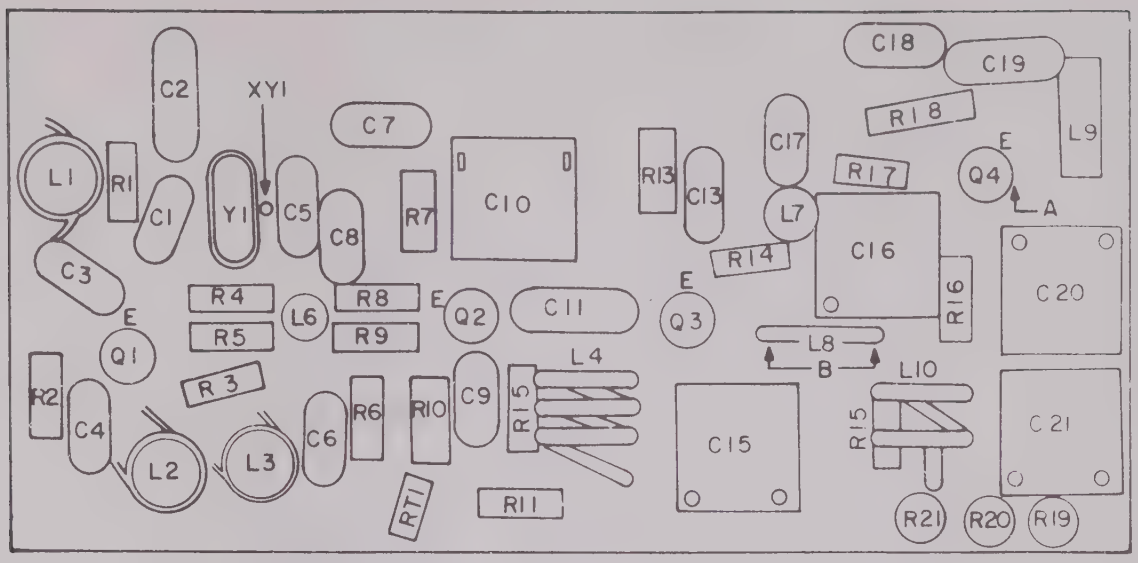
NOTES

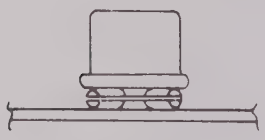
1. ALL RESISTORS ARE 1/4 WATT UNLESS OTHERWISE SPECIFIED AND RESISTOR VALUES IN OHMS UNLESS FOLLOWED BY K=1000 OHMS OR MEG = 1,000,000 OHMS. CAPACITOR VALUES IN PICOFARADS (EQUAL TO MICROMICROFARADS) UNLESS FOLLOWED BY UF= MICROFARADS. INDUCTANCE VALUES IN MICROHENRYS UNLESS FOLLOWED BY MH= MILLIHENRYS OR H=HENRYS.

Elementary Diagram

360 MHZ REFERENCE OSCILLATOR
PL-19C313434-G1, REV. A

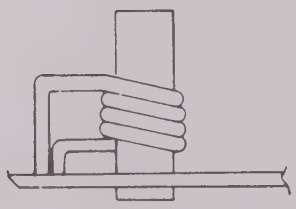
(Drawing No. 19D405917, Rev. 3)





DETAIL A

MOUNTING FOR Q3 & Q4

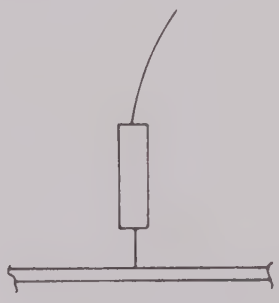


DETAIL C

MOUNTING FOR L1, L2 & L3

DETAIL B

MOUNTING FOR L8



DETAIL D

LEAD FORMING PERMISSIBLE
MOUNTING OF L6, L7, R21 & R20

LEAD IDENTIFICATION FOR Q1 & Q2

Service Outline

360 MHz REFERENCE OSCILLATOR
PL-19C313434-G1, REV. A

(Drawing No. 19C319095, Rev. 1)

PARTS LIST

REFERENCE OSCILLATOR BOARD
19C313434-G1 REV. A

SYMBOL	G-E PART NO.	DESCRIPTION
		- - - - - - - - - - CAPACITORS - - - - - - - - - -
C1	5496219-P245	Ceramic disc: 18 pf ±5%, 500 VDCW, temp coef -80 PPM.
C2	5496219-P257	Ceramic disc: 56 pf ±5%, 500 VDCW, temp coef -80 PPM.
C3	5496219-P36	Ceramic disc: 5.0 pf ±5%, 500 VDCW, temp coef 0 PPM.
C4 thru C6	5496219-P34	Ceramic disc: 3.0 pf ±5%, 500 VDCW, temp coef 0 PPM.
C7 thru C9	5494481-P107	Ceramic disc: 470 pf ±20%, 1000 VDCW; sim to RMC Type JF Discap.
C10	5491271-P109	Variable, sub-miniature: approx 2.6-19.7 pf, 750 v peak; sim to EF Johnson 189.
C11	7489162-P15	Silver mica: 33 pf ±5%, 500 VDCW; sim to Electro Motive Type DM-15.
*C12	7489162-P23 Deleted, Rev. A	Silver mica: 68 pf ±5%, 500 VDCW; sim to Electro Motive Type DM-15.
C13	19A116192-P2	Ceramic: 470 µf ±20%, 50 VDCW; temp range -55 to +85°C.
C15 and C16	5491271-P103	Variable, sub-miniature: approx 1.7-8.3 pf, 750 v peak; sim to EF Johnson 189.
C17	5494481-P107	Ceramic disc: 470 pf ±20%, 1000 VDCW; sim to RMC Type JF Discap.
C18	7491827-P2	Ceramic disc: .01 µf +80% -30%, 50 VDCW; sim to Sprague 19C180.
C19	7489162-P21	Silver mica: 56 pf ±5%, 500 VDCW; sim to Electro Motive Type DM-15.
C20	5491271-P103	Variable, sub-miniature: approx 1.7-8.3 pf, 750 v peak; sim to EF Johnson 189.
C21	5491271-P101	Variable, sub-miniature: approx 1.5-3.8 pf, 750 v peak; sim to EF Johnson 189.
		- - - - - - - - - - INDUCTORS - - - - - - - - - -
L1	19B208961-G6	Coil. Includes 19B200497-P2 tuning slug.
L2	19B208961-G9	Coil. Includes 19B200497-P2 tuning slug.
L3	19B208961-G5	Coil. Includes 19B200497-P2 tuning slug.
L4	19A102443-P1	Coil.
*L5	7488079-P3 Deleted, Rev. A	Choke, RF: 0.33 µh ±20%, 0.07 ohms DC res max; sim to Jeffers 4411-3M.
L6 and L7	7488079-P10	Choke, RF: 3.30 µh ±10%, 0.15 ohms DC res max; sim to Jeffers 4421-1K.
L8	19A102441-P1	Coil.
L9	7488079-P3	Choke, RF: 0.33 µh ±20%, 0.07 ohms DC res max; sim to Jeffers 4411-3M.
L10	19A102442-P1	Coil.
		- - - - - - - - - - TRANSISTORS - - - - - - - - - -
Q1 and Q2	19A115440-P1	Silicon, NPN.
Q3	19A115810-P1	Silicon, NPN; sim to Type 2N3866.
Q4	19A115329-P1	Silicon, NPN.
		- - - - - - - - - - RESISTORS - - - - - - - - - -
R1	3R152-P103J	Composition: 10,000 ohms ±5%, 1/4 w.
R2	3R152-P203J	Composition: 20,000 ohms ±5%, 1/4 w.
R3	3R152-P103J	Composition: 10,000 ohms ±5%, 1/4 w.
R4	3R152-P133J	Composition: 13,000 ohms ±5%, 1/4 w.
R5	3R152-P622J	Composition: 6200 ohms ±5%, 1/4 w.
R6	3R152-P100J	Composition: 10 ohms ±5%, 1/4 w.
R7	3R152-P101J	Composition: 100 ohms ±5%, 1/4 w.
R8	3R152-P222J	Composition: 2200 ohms ±5%, 1/4 w.
R9	3R152-P472J	Composition: 4700 ohms ±5%, 1/4 w.
R10	3R152-P152J	Composition: 1500 ohms ±5%, 1/4 w.
R11	3R152-P472J	Composition: 4700 ohms ±5%, 1/4 w.
R12	3R152-P751J	Composition: 750 ohms ±5%, 1/4 w.
R13	3R152-P102J	Composition: 1000 ohms ±5%, 1/4 w. (Used prior to Rev. A)
*R13	3R152-P103J	Composition: 10,000 ohms ±5%, 1/4 w. (Changed by Rev. A)
R14	3R152-P102J	Composition: 1000 ohms ±5%, 1/4 w.
R15	3R152-P180J	Composition: 18 ohms ±5%, 1/4 w.
R16	3R152-P152J	Composition: 1500 ohms ±5%, 1/4 w.
R17	3R152-P332J	Composition: 3300 ohms ±5%, 1/4 w.
R18	3R77-P561J	Composition: 560 ohms ±5%, 1/2 w. (Used prior to Rev. A)
*R18	3R77-P821J	Composition: 820 ohms ±5%, 1/2 w. (Changed by Rev. A)
R19	3R152-P301J	Composition: 300 ohms ±5%, 1/4 w.
R20	3R152-P180J	Composition: 18 ohms ±5%, 1/4 w.
R21	3R152-P301J	Composition: 300 ohms ±5%, 1/4 w.
		- - - - - - - - THERMISTORS - - - - - - - - - -
RT1	5490828-P9	Thermistor: 10,000 ohms ±10%, color code yellow; sim to Globar Type 551H-8.
		- - - - - - - - SOCKETS - - - - - - - -
XY1	19A115834-P1	Contact, electrical; sim to AMP 2-330808 8.
		- - - - - - - - CRYSTALS - - - - - - - -
Y1	19B206221-P1	Quartz: freq range 38.3 to 62 MHz, temp range -30°C to +80°C.
		- - - - - - - - MISCELLANEOUS - - - - - - - -
	4036555-P1	Insulator, washer: nylon. (Used with Q3 and Q4).

*COMPONENTS ADDED, DELETED OR CHANGED BY PRODUCTION CHANGES.

Chapter 4 Section I

PRINCIPLES OF OPERATION

70 MHZ OSCILLATOR
PL-19B220480-G1

GENERAL

The 70 MHz oscillator provides the reference input to the IF amplifier in the crystal controlled AFC reference assembly. It is constructed on a printed wire board that is located inside a shielded enclosure mounted behind the vent panel just above power supply "A".

SPECIFICATIONS

Output Frequency:	70 MHz
Supply Voltage:	-24 Vdc

CIRCUIT DESCRIPTION

The 70 MHz oscillator consists of an oscillator, a buffer amplifier, and a gating circuit that is used to turn the buffer on and off. The circuit description is made with reference to Elementary Diagram 19B217159 for the oscillator board, and to Elementary Diagram 19B220478 that shows how external connections are made to the oscillator circuit board. The circuitry on the oscillator circuit board is described first.

Transistor Q1 is a crystal-controlled Colpitts oscillator. Oscillator frequency (70 MHz) is determined by crystal Y1. The collector is tuned to this frequency by resonant circuit L2, C3 and C4. Signal from the oscillator appears across the attenuator and gain control network formed by resistors R5 through R8 and potentiometer R16, and is coupled into the buffer amplifier through C5.

Transistor Q2 is the buffer amplifier. It is connected in the common base configuration with its output tuned to the oscillator frequency by L4, C8 and C9. Note that the output must be terminated by a resistive (50-ohm) load so there will be current through diode CR1; the signal will be blocked if there is no current through CR1. The buffer amplifier is turned on and off by a square wave drive signal applied to a gating circuit.

The gating circuit consists of transistors Q3 and Q4. Transistor Q4 is turned off when the voltage at its base is at zero. This will cause the voltage at the base of Q3 to be sufficiently negative to make Q3 conduct. When Q3 conducts, bias circuit R9, R10 and R11 for buffer amplifier Q2 is grounded through Q3 and the buffer amplifier is turned on. When the voltage at the base of Q4 is sufficiently negative to turn it on, the common point between resistors R12, R13 and R14 is grounded. This will cause Q3 to turn off and the bias circuit for Q2 is opened so the buffer amplifier is turned off. Thus it can be seen that the buffer amplifier is turned on when the base of Q4 is zero, and off when the base of Q4 is driven negative. The gating transistors are operated by a square wave drive voltage applied to the base of Q4 through R15.

The circuitry external to the oscillator circuit board is shown on Elementary Diagram 19B220478. The -24 Vdc input required by the oscillator board is applied at terminal C1A. Oscillator output is taken through diode CR1 on the oscillator board and jack J1 on the shielded enclosure.

There are two pushbutton switches on the enclosure that are used for test purposes. One of them, S2, is a normally closed switch in series with the square wave drive signal applied to the oscillator board through terminal C2A and R15, and to the IF amplifier; the other, S1, is a normally open switch that can be used to connect -24 Vdc to terminal C2A and the IF amplifier. These two switches are used in conjunction with an RF voltmeter connected to the 70 MHz test jack on the waveguide assembly, to adjust the levels of the 70 MHz IF and the 70 MHz reference signals. When switch S2 is pushed in, the buffer amplifier in the oscillator is turned on, and the first two IF amplifier stages are turned off, so the signal measured at the test point is 70 MHz from the reference oscillator. When S1 is pushed in, the buffer amplifier in the oscillator is turned off, and the first two IF amplifier stages are turned on, so the signal measured at the test point is from the mixer/multiplier diode in the waveguide. Using this procedure, the two signals can be adjusted so they have equal amplitudes.

OFF FREQ ALARM switch S3 is in series with the input to the (optional) off frequency alarm unit. It is used to disable the alarm unit when it is necessary to perform maintenance procedures on those parts of the transmitter that have an effect on transmitter frequency.

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MAINTENANCE

70 MHZ REFERENCE OSCILLATOR PL-19B220480-G1

GENERAL

Maintenance procedures for the 70 MHz reference oscillator consists of checking the operation of the circuit for correct output level and frequency.

The 70 MHz reference oscillator is used as the reference frequency in the transmitter crystal AFC unit. It is housed with the (optional) AFC alarm unit and is mounted behind the vent panel just above power supply "A".

Regulated -24 Vdc source voltage is required for the maintenance test.

Refer to Elementary Diagrams 19B217159 and 19B220478.

TEST EQUIPMENT

The following items of test equipment (or the equivalent) are required.

Coaxial Termination	Hewlett-Packard 908A
Frequency Counter	Systron Donner 1017
Power Supply	Hewlett-Packard 721A
RF Voltmeter	Hewlett-Packard 411A
Tee Probe	Hewlett-Packard 11024A
Volt-Ohmmeter	Triplett

MAINTENANCE PROCEDURES

(1) Connect test equipment as shown in Figure 1.

(2) Set power supply output voltage to -24 ±0.5 Vdc.

(3) Set RF voltmeter to +10 dBm.

(4) Turn R16 on 70 MHz reference oscillator to maximum clockwise position; adjust L2 and L4 for maximum output. Level shall be more than +2 dBm.

(5) Press S1. Voltage at J2-A5 must be -24 ±0.5 Vdc.

(6) Press S2. Voltage at J2-A5 must be 0 Vdc.

(7) Set RF voltmeter to -30 dBm scale.

(8) Release S2 and press S1. Level at J1 must be more than 40 dBm.

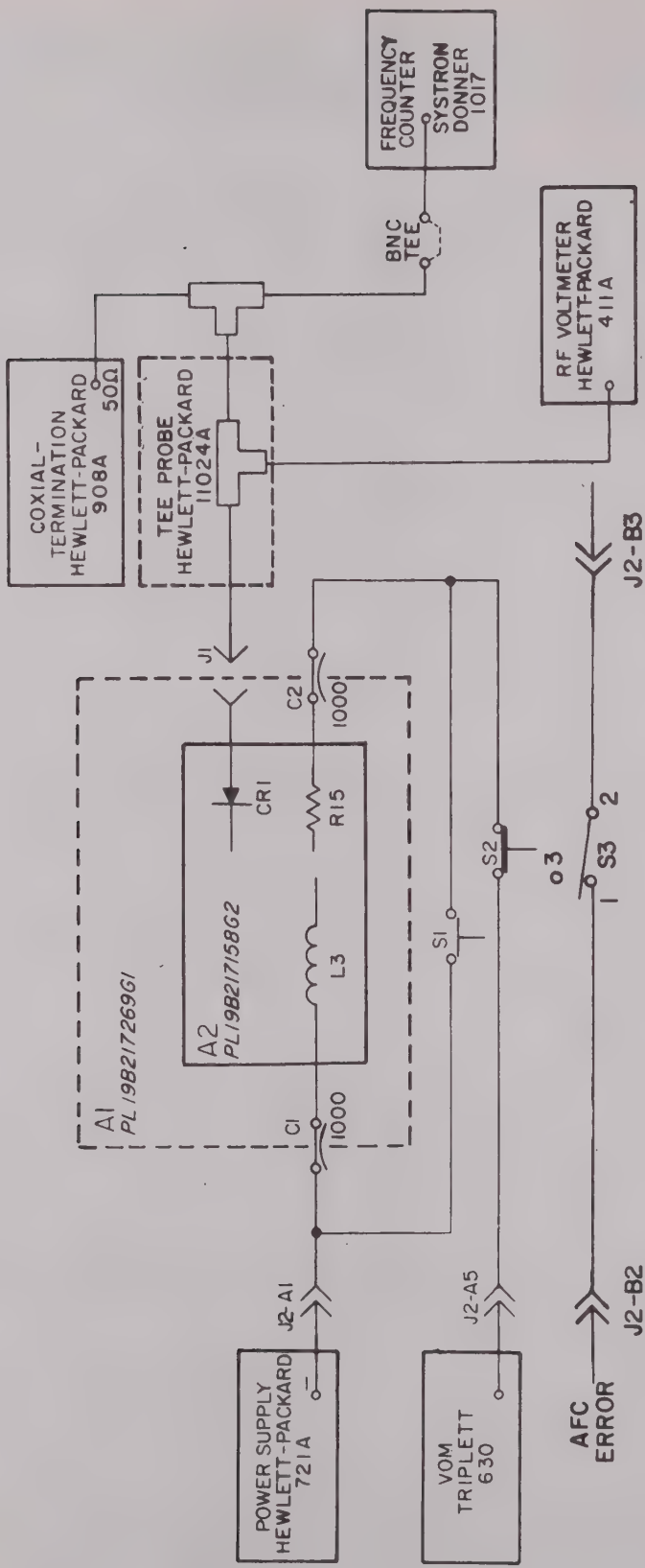

Figure 1. 70 MHz Reference Oscillator

(9) With frequency counter connected to BNC tee, check frequency. Frequency must be 70 MHz ±0.005%.

(10) Turn R16 counterclockwise until output level is 125 mV.

(11) Connect an ohmmeter from J2-B2 to J2-B3 to check operation of switch S3.

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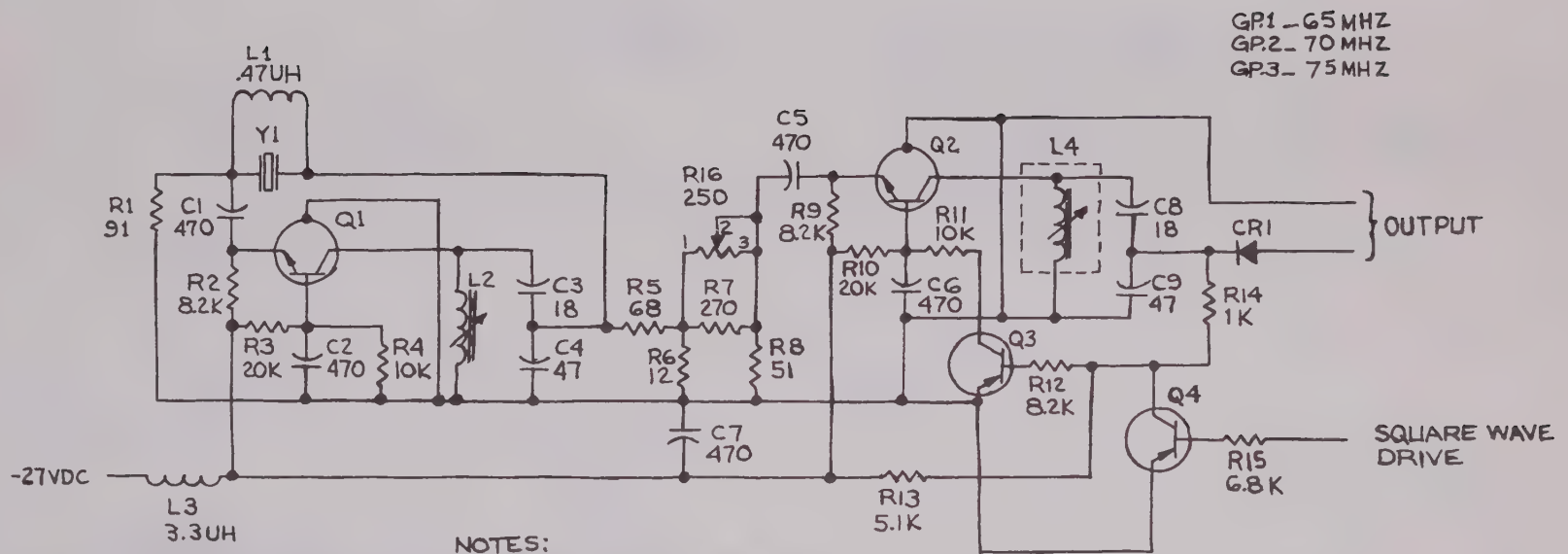


SEMI-CONDUCTOR CHART

ITEM NO.	GE IDENT. NO.	SIMILAR TO JEDEC NO. *
CR1	19A115250P1	
Q1, Q2	19A115440P1	
Q3, Q4	19A115768P1	2N3702

* FOR REFERENCE ONLY NOT RECOMMENDED FOR EXACT REPLACEMENT.

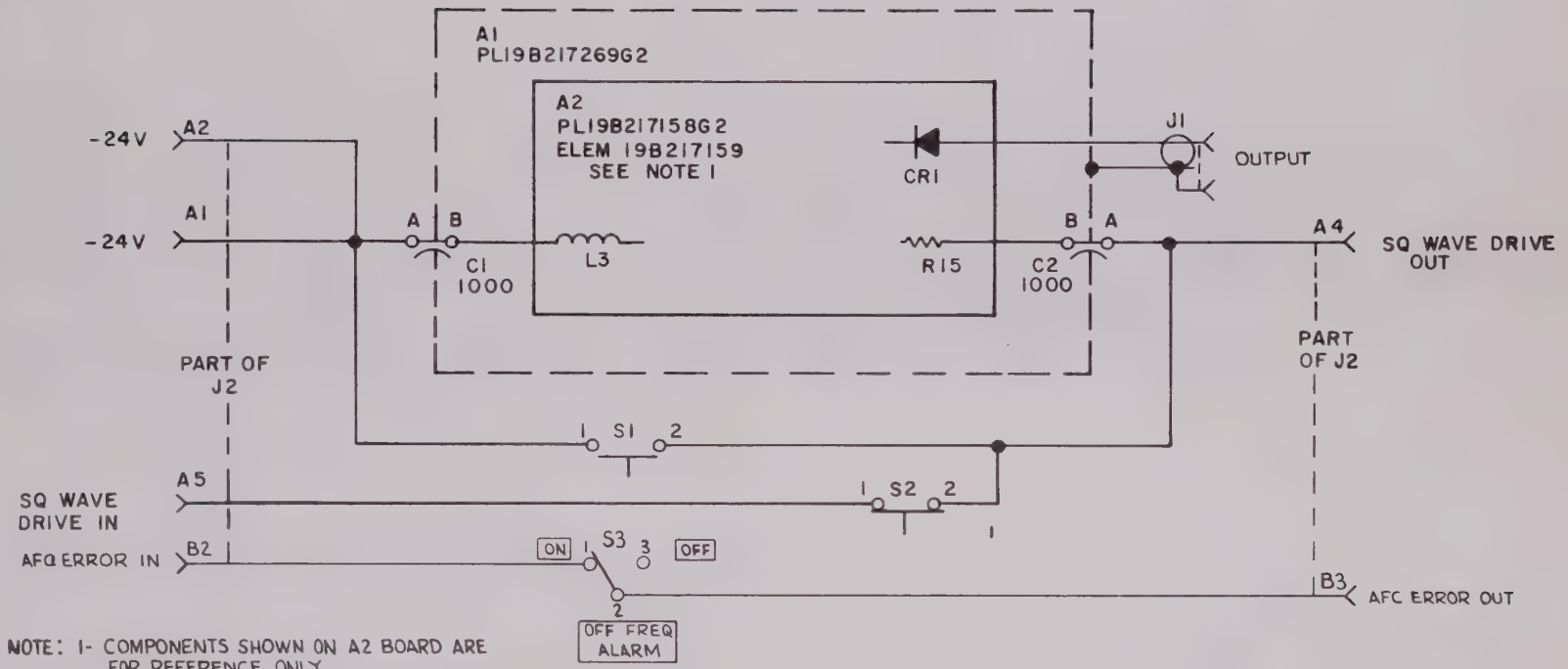
NOTES:

1. ALL RESISTORS ARE 1/4 WATT UNLESS OTHERWISE SPECIFIED AND RESISTOR VALUES IN OHMS UNLESS FOLLOWED BY K=1000 OHMS OR MEG = 1,000,000 OHMS. CAPACITOR VALUES IN PICOFARADS (EQUAL TO MICROMICROFARADS) UNLESS FOLLOWED BY UF = MICROFARADS. INDUCTANCE VALUES IN MICROHENRYS UNLESS FOLLOWED BY MH= MILLIHENRYS OR H=HENRYS.

Elementary Diagram

OSCILLATOR
PL-19B217158-G1 thru G3

(Drawing No. 19B217159, Rev. 2)



NOTE: 1- COMPONENTS SHOWN ON A2 BOARD ARE FOR REFERENCE ONLY.

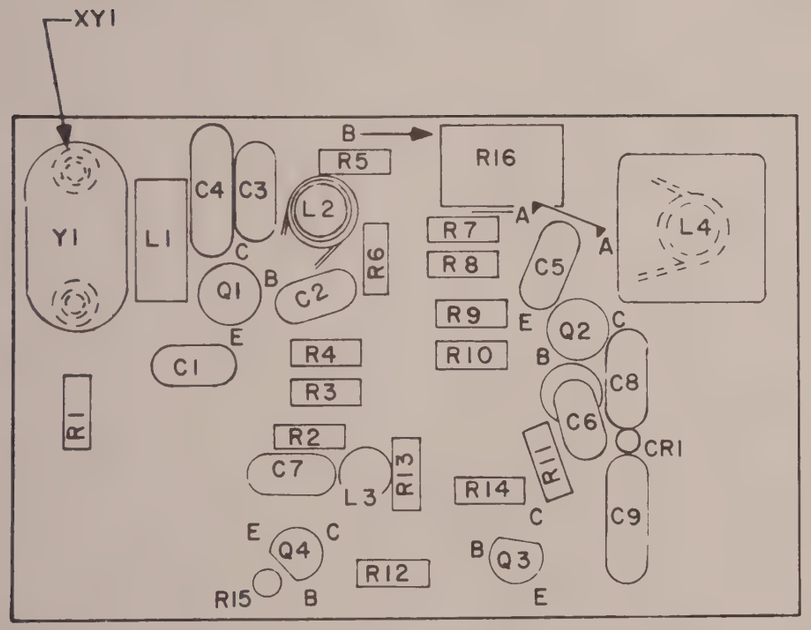
2- ALL RESISTORS ARE 1/2 WATT UNLESS OTHERWISE SPECIFIED AND RESISTOR VALUES IN OHMS UNLESS FOLLOWED BY K=1000 OHMS OR MEG = 1,000,000 OHMS. CAPACITOR VALUES IN PICOFARADS (EQUAL TO MICROMICROFARADS) UNLESS FOLLOWED BY UF = MICROFARADS. INDUCTANCE VALUES IN MICROHENRYS UNLESS FOLLOWED BY MH= MILLIHENRYS OR H=HENRYS.

3- [ ] INDICATES FRONT PANEL MARKING.

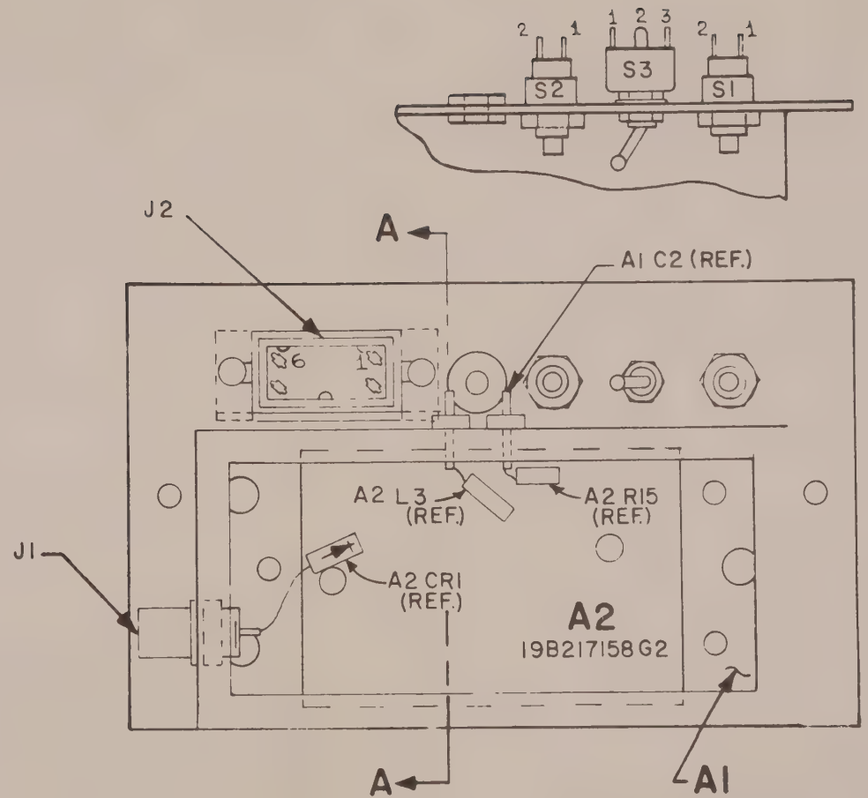
Elementary Diagram

70 MHZ OSCILLATOR
PL-19B220480-G1

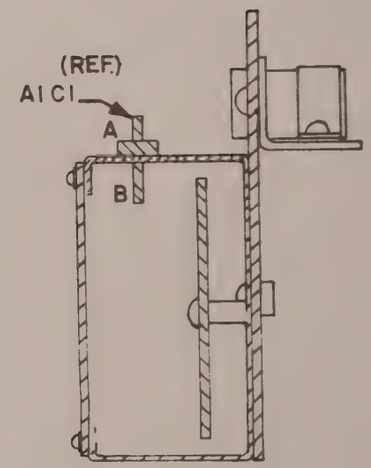
(Drawing No. 19B220478, Rev. 0)



VIEW OF A2

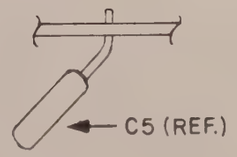


(WITH COVER REMOVED.)

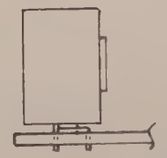


SECTION A-A

MOUNTING OF CR1

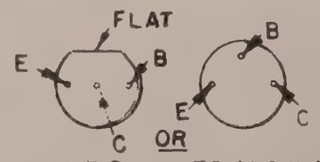


SECTION A-A



VIEW 'B'
MOUNTING FOR RIG.

LEAD IDENTIFICATION
FOR Q1-Q4



IN-LINE TRIANGULAR
VIEW FROM LEAD END

NOTE: LEAD ARRANGEMENT, AND NOT CASE SHAPE, IS DETERMINING FACTOR FOR LEAD IDENTIFICATION

Service Outline

70 MHZ OSCILLATOR
PL-19B220480-G1

(Drawing No. 19C316401, Rev. 0)

PARTS LIST

70 MHz OSCILLATOR
19B220480G1

SYMBOL	GE PART NO.	DESCRIPTION
A1		CAN ASSEMBLY 19B217269G2
		- - - - - - - - - CAPACITORS - - - - - - - - -
C1 and C2	5493392P7	Ceramic, feed-thru: .001 pf +100% -0%, 500 VDCW; sim to Allen-Bradley Type FA5C.
A2		OSCILLATOR BOARD 19B217158G2
		- - - - - - - - - CAPACITORS - - - - - - - - -
C1 and C2	5494481P7	Ceramic disc: 470 pf ±20%, 1000 VDCW; sim to RMC Type JF Discap.
C3	5496218P45	Ceramic disc: 18 pf ±5%, 500 VDCW, temp coef 0 PPM.
C4	5496218P55	Ceramic disc: 47 pf ±5%, 500 VDCW, temp coef 0 PPM.
C5 thru C7	5494481P7	Ceramic disc: 470 pf ±20%, 1000 VDCW; sim to RMC Type JF Discap.
C8	5496218P45	Ceramic disc: 18 pf ±5%, 500 VDCW, temp coef 0 PPM.
C9	5496218P55	Ceramic disc: 47 pf ±5%, 500 VDCW, temp coef 0 PPM.
		- - - - - - - DIODES AND RECTIFIERS - - - - - -
CR1	19A115250P1	Silicon.
		- - - - - - - - - - INDUCTORS - - - - - - - - -
L1	7488079P4	Choke, RF: 0.47 µh ±20%, 0.09 ohms DC res max; sim to Jeffers 4411-4.
L2	19B208961G4	Coil. Includes:
	19B200497P2	Tuning slug.
L3	7488079P10	Choke, RF: 3.30 µh ±10%, 0.15 ohms DC res max; sim to Jeffers 4421-1.
L4	19B208961G3	Coil. Includes:
	19B200497P2	Tuning slug.
		- - - - - - - - - TRANSISTORS - - - - - - - - -
Q1 and Q2	19A115440P1	Silicon; NPN.
Q3 and Q4	19A115768P1	Silicon, PNP; sim to Type 2N3702.
		- - - - - - - - - RESISTORS - - - - - - - - -
R1	3R152P910J	Composition: 91 ohms ±5%, 1/4 w.
R2	3R152P822J	Composition: 8200 ohms ±5%, 1/4 w.
R3	3R152P203J	Composition: 20,000 ohms ±5%, 1/4 w.
R4	3R152P103J	Composition: 10,000 ohms ±5%, 1/4 w.
R5	3R152P680J	Composition: 68 ohms ±5%, 1/4 w.
R6	3R152P120J	Composition: 12 ohms ±5%, 1/4 w.
R7	3R152P271J	Composition: 270 ohms ±5%, 1/4 w.
R8	3R152P510J	Composition: 51 ohms ±5%, 1/4 w.
R9	3R152P822J	Composition: 8200 ohms ±5%, 1/4 w.
R10	3R152P203J	Composition: 20,000 ohms ±5%, 1/4 w.
R11	3R152P103J	Composition: 10,000 ohms ±5%, 1/4 w.
R12	3R152P822J	Composition: 8200 ohms ±5%, 1/4 w.
R13	3R152P512J	Composition: 5100 ohms ±5%, 1/4 w.
R14	3R152P102J	Composition: 1000 ohms ±5%, 1/4 w.
R15	3R152P682J	Composition: 6800 ohms ±5%, 1/4 w.
R16	19A116559P3	Variable, cermet: 250 ohms ±20%, 1/2 w; sim to CTS Series 360.
		- - - - - - - - - - SOCKETS - - - - - - - - - -
XY1	5490557P2	Contact, crystal: (printed wiring), 4-fingers, brass. (Quantity 2).
Y1	4036966P1	Crystal: freq 70 MHz ±0.005%, temp range -20° to 75°C.
		- - - - - - - - JACKS AND RECEPTACLES - - - - - - - -
J1	7776570P17	Receptacle, bulkhead: coaxial, 500 v peak. Military Type UG-1094/U.
J2	19B209427P3	Plug: 12 contacts, 8.5 amps, 600 VRMS; sim to Elco 00-8024-012-000-003.
		- - - - - - - - - - SWITCHES - - - - - - - - - -
S1	7481654P6	Pushbutton: single pole, normally open, 1/10 amp at 115 VAC or 1/2 amp at 115 VAC; sim to Grayhill 30-1.
S2	7481654P7	Pushbutton: single pole, normally closed, 1/10 amp at 115 VAC; sim to Grayhill 30-2.
S3	4036949P1	Toggle: SPDT, 100 µa at 5 VDC, mounting hardware; sim to Arrow-Hart and Hegeman TS-3.

*COMPONENTS ADDED, DELETED OR CHANGED BY PRODUCTION CHANGES

PRINCIPLES OF OPERATION
TRS-696B REGULATOR AND AFC START CIRCUIT
PL-19B220137-G1

GENERAL

The regulator and AFC start circuit is a part of the transmitter RF oscillator unit. Functionally, it consists of two separate circuits. The voltage regulator portion provides the stable operating voltage required by the RF oscillator/modulator. The AFC start portion provides an output control voltage used to charge the AFC amplifier output capacitors very quickly after the power supply is turned on; this prevents development of a "lock-out" (the inability of the AFC to pull the transmitter on-frequency) condition in the AFC loop.

The regulator and AFC start circuit is packaged on a printed wire board that is mounted inside the transmitter RF oscillator chassis. Connections are made by push-on plugs and three solder posts.

SPECIFICATIONS

Regulator

Input Voltage:	-32 Vdc
Output Voltage (variable):	-20 to -27.5 Vdc, -28.1 Vdc max.
Output Current (typical maximum):	300 mA
Regulation (1 volt input change):	less than 20 mV
-20°C to +70°C, +25°C reference:	less than ±100 mV
Short Circuit Current:	less than 550 mA

AFC Start

Input Voltage:	-24 Vdc
Control Input Voltage:	-6 to -13 Vdc ±5%
Control Output Voltage:	17.0 to 20.6 ±0.5 Vdc

CIRCUIT DESCRIPTION

The regulator and AFC start circuits are described separately with reference to Elementary Diagram 19D409273. Refer to Service Outline 19B220137 for parts location.

Voltage Regulator:

The voltage regulator consists of a series regulator, a zener diode referenced differential amplifier and a current-limited short protection circuit.

Input voltage, -32 Vdc, is applied to A1-J1. The load current passes through series regulator Q1 (mounted on the chassis) and current detector resistor A1-R5 to the load connected to A1-E3. A sample of the output voltage, taken from divider A1-R12, A1-R13, A1-R14, is applied to the base of A1-Q5. Transistors A1-Q4 and the reference voltage for the amplifier that is applied to the base of A1-Q4. The output of the amplifier is taken at the collector of A1-Q5, and is used to control current source A1-Q3. Transistor A1-Q3 controls the bias to driver A1-Q1 which in turn controls series regulator Q1.

A change of input voltage or load current will cause a corresponding change in voltage applied from A1-R13 to differential amplifier A1-Q4, A1-Q5 which, by controlling transistors A1-Q3 and A1-Q1, will change the base drive of series regulator Q1 to maintain a constant output voltage. The output voltage can be adjusted from -20 to -27.5 Vdc by potentiometer A1-R13. Resistor A1-R12 is selected so maximum output voltage is limited to -28.1 Vdc in order to protect the oscillator/modulator transistor.

Load current is limited by A1-Q2 and A1-R5. When load current is in the normal range (the typical maximum is 300 mA), transistor A1-Q2 is turned off. If load current increases to abnormal levels, the voltage developed across A1-R5 is sufficient to turn A1-Q2 on. This limits the base drive to transistor A1-Q1 which, in turn, limits the base drive to series regulator Q1. Short circuit current is limited to less than 550 mA. The drop across A1-R5 is used by the rack metering circuit as a measure of oscillator current.

AFC Start:

The AFC start circuit is comprised of transistors A1-Q6 and A1-Q7. It is essentially a low impedance voltage source that is active for approximately six seconds after the power supply is turned on.

When the power supply is turned on, an input control voltage appears at A1-J3, and -24 Vdc is applied to A1-J2. The input control voltage plus the drop across zener diode A1-VR3 is applied to the base of emitter follower A1-Q7. The emitter follower is turned on and its low impedance output is connected to the varactor through A1-CR1 and A1-J9. The output is limited to -24 Vdc minus the saturation voltage of A1-Q7, and the voltage drops across diode A1-CR3 and resistor A1-R20. At the same time, capacitor A1-C3 in the base circuit of A1-Q6 begins to charge through A1-R25. Transistor A1-Q6 is off.

After A1-C3 has charged to a level sufficient to turn A1-Q6 on, the collector of A1-Q6 is at nearly zero volts. Diode A1-CR2 is now forward biased, and the base of A1-Q7 is forced to approximately -1 Vdc. Emitter follower A1-Q7 is turned off and diode A1-VR3 is reverse biased, removing the start control voltage from the AFC loop. If the rack power supply is turned off, A1-C3 is quickly discharged through A1-CR1 and A1-R23. Test point A1-E6 can be grounded to force A1-Q6 off and A1-Q7 on for the purpose of checking the control output voltage.

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GENERAL ELECTRIC COMPANY
LYNCHBURG, VIRGINIA

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MAINTENANCE
TRS-696B REGULATOR AND AFC START
PL-19B220137-G1

GENERAL

Bench maintenance procedures for the regulator and AFC start circuit consists of DC voltage and current measurements that are made on its printed wire board which is located in the transmitter RF oscillator chassis. Refer to Elementary Diagram 19D409273, and to Service Outline 19B220137.

TEST EQUIPMENT

The following items of test equipment (or the equivalent) are required.

DC Voltmeter	John Fluke Model 825A or 881A
Power Supply	Hewlett-Packard 721A

MAINTENANCE PROCEDURE

CAUTION

To prevent possible damage to the oscillator/ modulator during tests, disconnect the wires connected to FL1 and FL2 on the RF oscillator/ modulator.

1. Connect the test jig shown in Figure 1 to jack J1 on the transmitter RF oscillator chassis.

2. Turn A1-R13 fully clockwise (CW). The current drawn from the -32 Vdc source should be approximately 300 mA.

3. Measure the regulator output voltage at TP4; it should be at least -27.5 Vdc but not greater than -28.1 Vdc. If voltage is out of range, remove resistor A1-R12, substitute a decade box and use the decade box to determine the value of resistance needed to limit the maximum output voltage to no more than -28.1 Vdc. Install new resistor (use a metal film, 2%, 1/2 watt type resistor such as GE Part No. 19A116278).

4. Turn A1-R13 fully counterclockwise (CCW). The voltage at TP4 should be less than -20 Vdc but greater than -17 Vdc.

5. Adjust A1-R13 for -25 Vdc at TP4.

6. Measure the bias voltage at A1-E4; it should be -22.75 $\pm$0.2 Vdc.

7. Short TP4 to TP3. The short circuit current (measured at -32 Vdc input TP8) should not be greater than 550 mA. Remove short.

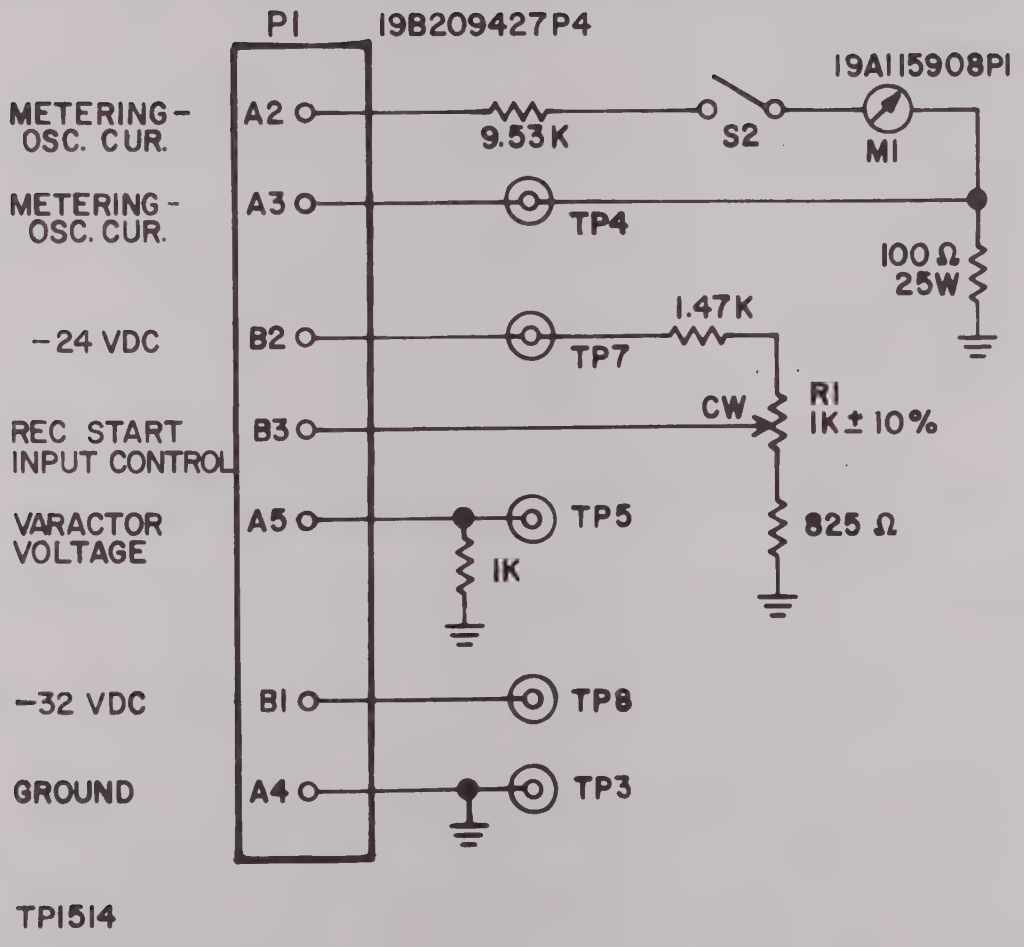

Figure 1. Test Jig

8. Short A1-E6 to ground with a clip lead.

9. Adjust AFC start control R1 on test jig fully clockwise (CW). The voltage at TP5 should be -20.6 ±0.5 Vdc.

10. Adjust R1 fully counterclockwise (CCW). The voltage at TP5 should be -17.0 ±0.5 Vdc.

11. Remove short to ground at A1-E6. The voltage at TP5 should now be less than 1 volt.

12. Close switch S2 and read meter M1. Indication should be 0.92 of red line ±1 small division.

13. Disconnect test equipment and reconnect wires to the RF oscillator/modulator.

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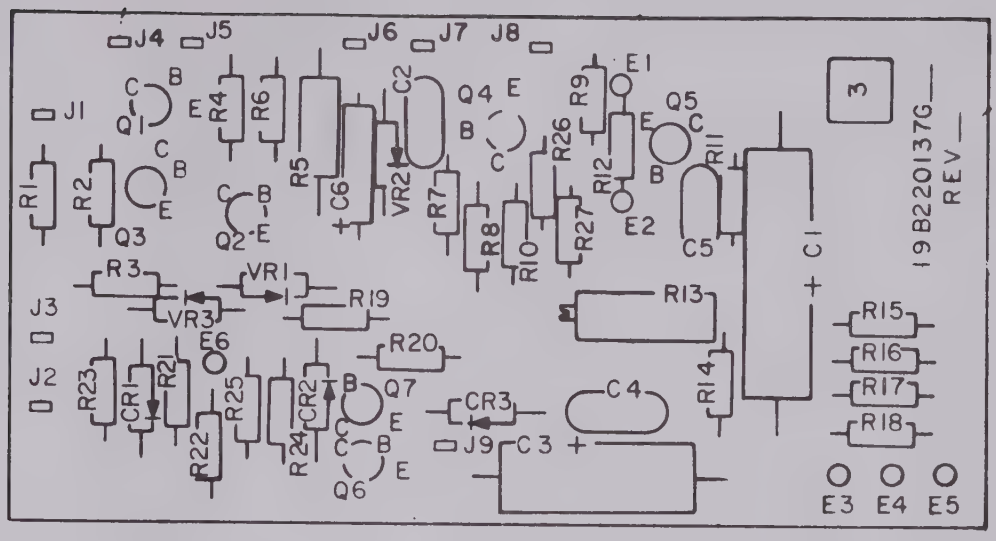
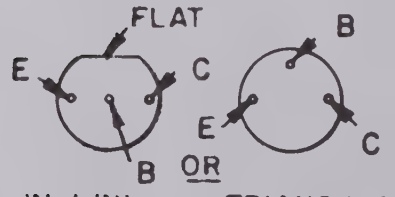
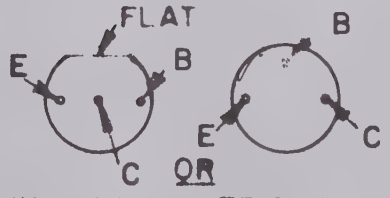


LEAD IDENTIFICATION
FOR Q1-Q3,Q6 & Q7



IN-LINE TRIANGULAR
VIEW FROM LEAD END

LEAD IDENTIFICATION
FOR Q4 & Q5



IN-LINE TRIANGULAR
VIEW FROM LEAD END

NOTE: LEAD ARRANGEMENT, AND NOT CASE SHAPE, IS DETERMINING FACTOR FOR LEAD IDENTIFICATION.

Service Outline

TRS-69B REGULATOR AND AFC START
PL-19B220137-G1

(Drawing No. 19B220137, Rev. 2)

PARTS LIST

REGULATOR AND AFC START
19B220137G1

SYMBOL	GE PART NO.	DESCRIPTION
		- - - - - - - - - CAPACITORS - - - - - - - - -
C1	19A115680P12	Electrolytic: 100 µf +150% -10%, 30 VDCW; sim to Mallory Type TT.
C2	19A116080P101	Polyester: 0.01 µf ±10%, 50 VDCW.
C3	19A115680P14	Electrolytic: 300 µf +150% -10%, 7 VDCW; sim to Mallory Type TT.
C4	19A116080P107	Polyester: 0.1 µf ±10%, 50 VDCW.
C5	19A116080P101	Polyester: 0.01 µf ±10%, 50 VDCW.
C6	5496267P18	Tantalum: 6.8 µf ±20%, 35 VDCW; sim to Sprague Type 150D.
		- - - - - - - DIODES AND RECTIFIERS - - - - -
CR1	4038056P1	Germanium.
CR2 and CR3	19A115250P1	Silicon.
		- - - - - - - - - - TERMINALS - - - - - - - - -
E1 thru E6	19A115296P1	Terminal, standoff: sim to Cambridge Thermionic Corp X1558-BB.
		- - - - - - - JACKS AND RECEPTACLES - - - - - -
J1 thru J9	19A116361P4	Contact, electrical: sim to Malco 14A117-12.
		- - - - - - - - - - TRANSISTORS - - - - - - - - -
Q1	19A115562P1	Silicon, PNP.
Q2 and Q3	19A115852P1	Silicon, PNP; sim to Type 2N3906.
Q4 and Q5	19A115362P1	Silicon, NPN; sim to Type 2N2925.
Q6 and Q7	19A115852P1	Silicon, PNP; sim to Type 2N3906.
		- - - - - - - - - - RESISTORS - - - - - - - - -
R1	19A116278P229	Metal film: 1960 ohms ±2%, 1/2 w.
R2	19A116278P345	Metal film: 28,700 ohms ±2%, 1/2 w.
R3	19A116278P169	Metal film: 511 ohms ±2%, 1/2 w.
R4	19A116278P201	Metal film: 1000 ohms ±2%, 1/2 w.
R5	19A115416P10	Wirewound: 1.00 ohms ±1%, 2 w; sim to Dale Type RS-2B.
R6	19A116278P101	Metal film: 100 ohms ±2%, 1/2 w.
R7	19A116278P221	Metal film: 1620 ohms ±2%, 1/2 w.
R8	19A116278P253	Metal film: 3480 ohms ±2%, 1/2 w.
R9	19A116278P213	Metal film: 1330 ohms ±2%, 1/2 w.
R10 and R11	19A116278P249	Metal film: 3160 ohms ±2%, 1/2 w.
R12	19A116278P229	Metal film: 1960 ohms ±2%, 1/2 w.
R13	19A116430P5	Variable, cermet: 1000 ohms ±10%, 0.75 w.
R14	19A116278P285	Metal film: 7500 ohms ±2%, 1/2 w.
R15	19A116278P169	Metal film: 511 ohms ±2%, 1/2 w.
R16	19A116278P269	Metal film: 5110 ohms ±2%, 1/2 w.
R17 and R18	19A116278P229	Metal film: 1960 ohms ±2%, 1/2 w.
R19	19A116278P269	Metal film: 5110 ohms ±2%, 1/2 w.
R20	19A116278P301	Metal film: 10,000 ohms ±2%, 1/2 w.
R21	19A116278P337	Metal film: 23,700 ohms ±2%, 1/2 w.
R22	19A116278P229	Metal film: 1960 ohms ±2%, 1/2 w.
R23	19A116278P33	Metal film: 21.5 ohms ±2%, 1/2 w.
R24	19A116278P317	Metal film: 14,700 ohms ±2%, 1/2 w.
R25	19A116278P365	Metal film: 46,400 ohms ±2%, 1/2 w.
R26 and R27	19A116278P53	Metal film: 34.8 ohms ±2%, 1/2 w.
		- - - - - - VOLTAGE REGULATORS - - - - - - - -
VR1 and VR2	4036887P51	Silicon, Zener.
VR3	4036887P53	Silicon, Zener.

*COMPONENTS ADDED, DELETED OR CHANGED BY PRODUCTION CHANGES

PRINCIPLES OF OPERATION
TRS-696B TRANSMITTER BASEBAND AMPLIFIER
PL-19B220177-G1

GENERAL

The transmitter baseband amplifier is a part of the transmitter RF oscillator unit. Its function is to raise signals applied to it to the level required to modulate the RF oscillator/modulator. Two signal input circuits are provided. One of these is for the composite baseband signal (message channels) and the other is for the (optional) service channel signal. The output signal is applied to the RF oscillator/modulator. An additional output circuit provides signal for monitoring purposes. The baseband amplifier is located in the transmitter RF oscillator chassis on the transmitter shelf.

SPECIFICATIONS

Signal Input	
Baseband:	-42 dBm/channel (-45 dBm/channel can be used for special applications)
Service Channel:	715 mV rms/channel
Input Impedance	
Baseband:	3.5K ohms (75 ohms when externally terminated in 78.6 ohms at J4)
Service Channel:	17K ohms
Maximum Gain:	31.4 dB; 34.4 dB available (with strapping) for special applications only.
Frequency Response:	±0.15 dB, 300 Hz to 8.5 MHz
Output Monitor Impedance:	75 ohms, USE 75Ω SHUNT &
Maximum Output Monitor Level:	-20 dBm/channel (SET @ 40 mV peak-to
Operating Voltage:	-24 Vdc

CIRCUIT DESCRIPTION

The transmitter baseband amplifier circuit is described in four parts: (1) baseband (message channel) input circuit, (2) amplifier circuit, (3) service channel input circuit, and (4) output monitor circuit. Each part is described with reference to Elementary Diagram 19D409273. Refer to Service Outline 19B220177 for parts location.

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Baseband Input Circuit:

Normally, the baseband input signal is applied at BB INPUT jack J4, which is a 3.5K input when switch A2-S1 is in OPERATE position. A 75-ohm input is obtained by connecting an external 78.6-ohm resistor on the Tee connector connected to J4. The input signal can be monitored with a high-impedance meter at INPUT MON jack J3.

When switch A2-S1 is in TEST position, baseband signal applied at BB INPUT jack J4 is disconnected from the amplifier. A test signal may be injected at TEST INPUT jack J3 which is a 75-ohm input.

Amplifier Circuit:

The amplifier circuit consists of two doublet (two-stage amplifier with feedback loop) stages connected in cascade. The first doublet is dc-coupled and the second is ac-coupled.

Transistors A2-Q3 and A2-Q4 form the first doublet. Signal is applied to the base of A2-Q3 through A2-C4. Overall gain is about 18 dB and the output, taken from the collector of A2-Q4, is applied to the divider formed by gain control A2-R26 and resistor A2-R27 through A2-C10 and A2-R23. The gain control has a range of 12 dB. Overall gain can be altered by removal of jumper 'A' or 'B'; overall gain can be increased 3 dB by removal of jumper 'A', or decreased 6.7 dB by removal of jumper 'B'.

The second doublet is formed by A2-Q5 and Q2-Q6. Input signal is applied to the base of A2-Q5 through A2-C11 and A2-R31. Capacitor A2-C13, connected across the feedback network, is used to adjust frequency response. Overall gain of the second doublet is about 14 dB and the output signal, taken from the collector of A2-Q6 through A2-C16, is applied to the RF oscillator/modulator.

Service Channel Input Circuit:

Service channel input signal is combined with message channel signal at the output of the first doublet. Service channel signal is applied at SC INPUT jack J2 and coupled to the base of emitter follower A2-Q1 through A2-C2 and A2-R4. The output of A2-Q1 is applied through gain setting resistors A2-R6 and A2-R7 to the base of emitter follower A2-Q2. The output of A2-Q2 is combined with the message channel signal through A2-C3 and A2-R24. The circuit is arranged so service channel signal will be at the per-channel level when it is combined with the message channel signal. When message channel input level is -42 dBm/channel (without emphasis), jumper 'C' is in place and only A2-R6 is in series with the output of A2-Q1; when emphasis is used, jumper 'C' is removed so resistors A2-R6 and A2-R7 are in series with the output of A2-Q1, and an additional 4 dB of attenuation is thus provided.

Output Monitor Circuit:

The output monitor circuit consists of transistors A2-A7 and A2-Q8 that form a pair of emitter followers connected in series. Signal from the amplifier circuit is applied to the base of A2-Q7 through

A2-C15, A2-R41 and A2-R42. The output signal is taken from the emitter of A2-Q8 through A2-R46, A2-C19 and OUTPUT MON jack J5. The level of signal at J5 is a function of RF oscillator/modulator sensitivity. When the gain of the amplifier is set to test gain (25.4 dB), the output monitor level is -25.6 dBm for an input signal level of -42 dBm.

TELECOMMUNICATION PRODUCTS DEPARTMENT
GENERAL ELECTRIC COMPANY
LYNCHBURG, VIRGINIA

Printed in U.S.A.

MAINTENANCE
TRS-696B TRANSMITTER BASEBAND AMPLIFIER
PL-19B220177-G1

GENERAL

Bench maintenance procedures for the transmitter baseband amplifier consist of: (1) ac and dc voltage measurements, (2) frequency response measurements, and (3) baseband amplifier and service channel gain adjustments. The dc measurements, taken at selected points of the ac- and dc-coupled doublet stages, provide a good indication of the static operation, while the ac measurements provide an indication of the dynamic operation of the circuitry. Typical voltage readings are given in the maintenance procedures. Because of impedance variations, frequency response should be checked as specified in Chapter 3 when the baseband amplifier is reinstalled in the rack.

An OPERATE/TEST switch and two coaxial jacks are provided as maintenance aids. When the switch is in TEST position, TEST INPUT jack J3 is terminated in 75 ohms internally. TEST INPUT jack J3 and OUTPUT MON jack J5 facilitate test signal connections to the baseband amplifier. Use standard 75-ohm coaxial cable for all test setup connections.

Refer to Elementary Diagram 19D409273, and to Service Outline 19B220177. The steps of each procedure must be performed in the order given.

TEST EQUIPMENT

The following items of test equipment (or the equivalent) are required.

DC voltmeter	Hewlett-Packard 412A
AC voltmeter	Hewlett-Packard 400EL
Power Supply	Hewlett-Packard 721A
Test Oscillator	Hewlett-Packard 651B-02

MAINTENANCE PROCEDURES

The transmitter RF oscillator chassis is connected into the test setup shown in Figure 1 for each of the following procedures.

Voltage Measurements:

1. Turn the power supply on.
2. Use the dc voltmeter to measure the voltage at test points listed in Table 1.
3. Set OPERATE/TEST switch to TEST.
4. Set test oscillator frequency to 1 kHz and output level to 6.15 mV at TEST INPUT jack J3.

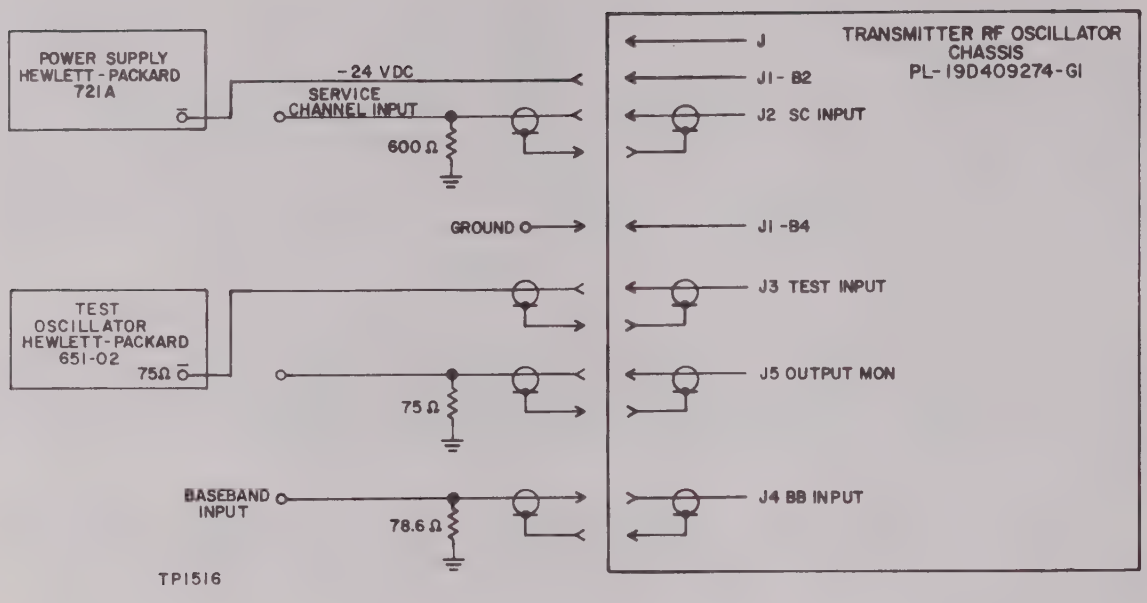

Figure 1. Test Setup for Transmitter Baseband Amplifier

VOLTAGE TEST POINT	DC VOLTAGE (TYPICAL)
Q3 collector	-7.5 Volts
Q4 collector	-13.5 Volts
Q5 collector	-14.8 Volts
Q1 emitter	-8.6 Volts
Q2 emitter	-8.4 Volts
Q6 collector	-7.1 Volts
Q7 emitter	-9.4 Volts
Q8 emitter	-9.9 Volts

Table 1. DC Voltage Measurements (Typical)

5. Set the GAIN ADJ control fully clockwise (cw), and use the ac voltmeter to measure the voltage at test points listed in Table 2.

VOLTAGE TEST POINT	AC VOLTAGE (TYPICAL)
Q4 collector	57 millivolts
Q5 collector	90 millivolts
Q6 collector	225 millivolts
Q7 emitter	160 millivolts
J5 OUTPUT MON	78 millivolts

Table 2. AC Voltage Measurements (Typical)

Frequency Response:

1. With power supply turned off, check and record connection status of jumpers 'A', 'B', 'C' and 'D' (jumpers will have to be restored to the status recorded when test is completed).

2. Jumpers 'A', 'B', 'C' and 'D' must be in place for this test; connect those (if any) found missing in Step 1.

3. Turn power supply on.

4. Set test oscillator frequency to 300 kHz and output level to 6.15 mV at the TEST INPUT jack.

5. Terminate the ac voltmeter in 75 ohms and connect it to the OUTPUT MON jack.

6. Set the GAIN ADJ control to obtain a reading of 40.7 mV on the ac voltmeter. Do not readjust the GAIN ADJ control.

7. Vary the frequency of test oscillator from 300 Hz to 8.5 MHz while maintaining the input level constant at 6.15 mV. The output shall not vary more than $\pm$0.5 dB.

NOTE

Capacitor A2-C13 may be adjusted to bring the frequency response within limits.

Baseband Amplifier and Service Channel Gain:

1. Set the GAIN ADJ control fully clockwise (cw).

2. Set test oscillator frequency to 300 kHz and output level to 6.15 mV at the TEST INPUT jack.

3. Monitor the output voltage at the OUTPUT MON jack with the ac voltmeter; it should be 83 $\pm$3 mV.

NOTE

An additional 3 dB of gain is realized when jumper 'A' has been removed.

4. Set test oscillator frequency to 10 kHz and output level to 6.15 mV at the TEST INPUT jack. Adjust GAIN ADJ control to obtain a reading of 40.7 mV at the OUTPUT MON jack.

5. Disconnect the test oscillator from TEST INPUT jack, and connect it to SC INPUT jack J2.

6. Set test oscillator frequency to 10 kHz and output level to 715 mV at the SC INPUT jack.

7. Monitor output voltage at the OUTPUT MON jack with the ac voltmeter; it should be 14.5 $\pm$0.4 mV.

8. Remove jumper 'C'. Signal level at the OUTPUT MON jack should be 9.2 $\pm$0.4 mV.

9. Disconnect test equipment. Reconnect jumpers 'A', 'B', 'C' and 'D' to the status recorded in step 1 of the "Frequency Response" procedure.

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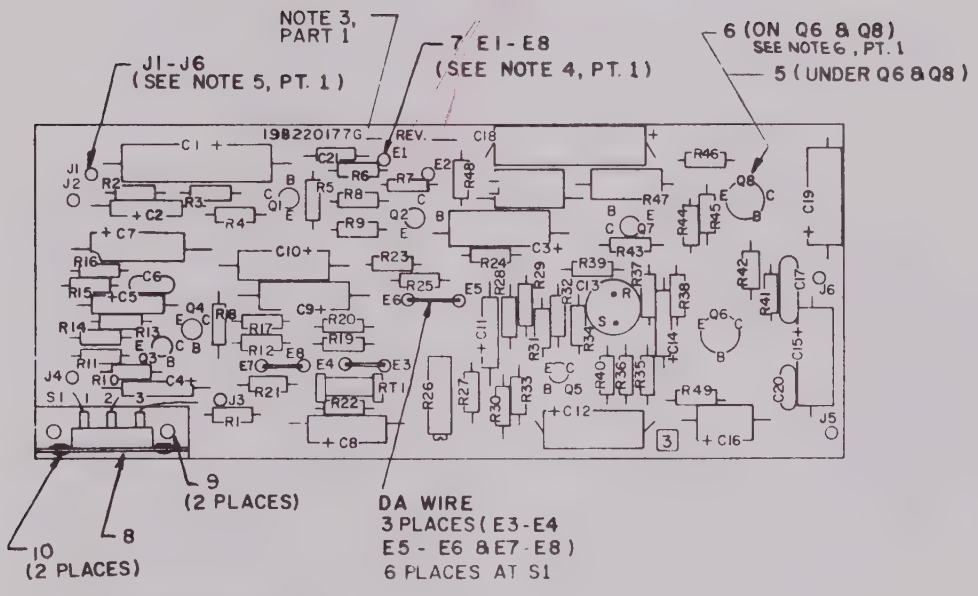
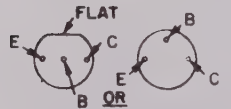

NOTE 3, PART 1
J1-J6 (SEE NOTE 5, PT. 1)
7 E1-E8 (SEE NOTE 4, PT. 1)
6 (ON Q6 & Q8) SEE NOTE 6, PT. 1
5 (UNDER Q6 & Q8)
19B220177G REV.
9 (2 PLACES)
10 (2 PLACES)
8
DA WIRE 3 PLACES (E3-E4 E5 - E6 & E7 - E8) 6 PLACES AT S1

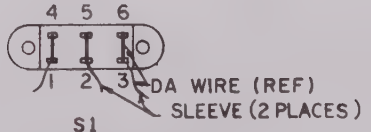
LEAD IDENTIFICATION FOR Q1 – Q8



IN-LINE TRIANGULAR

VIEW FROM LEAD END

NOTE: LEAD ARRANGEMENT, AND NOT CASE SHAPE, IS DETERMINING FACTOR FOR LEAD IDENTIFICATION.



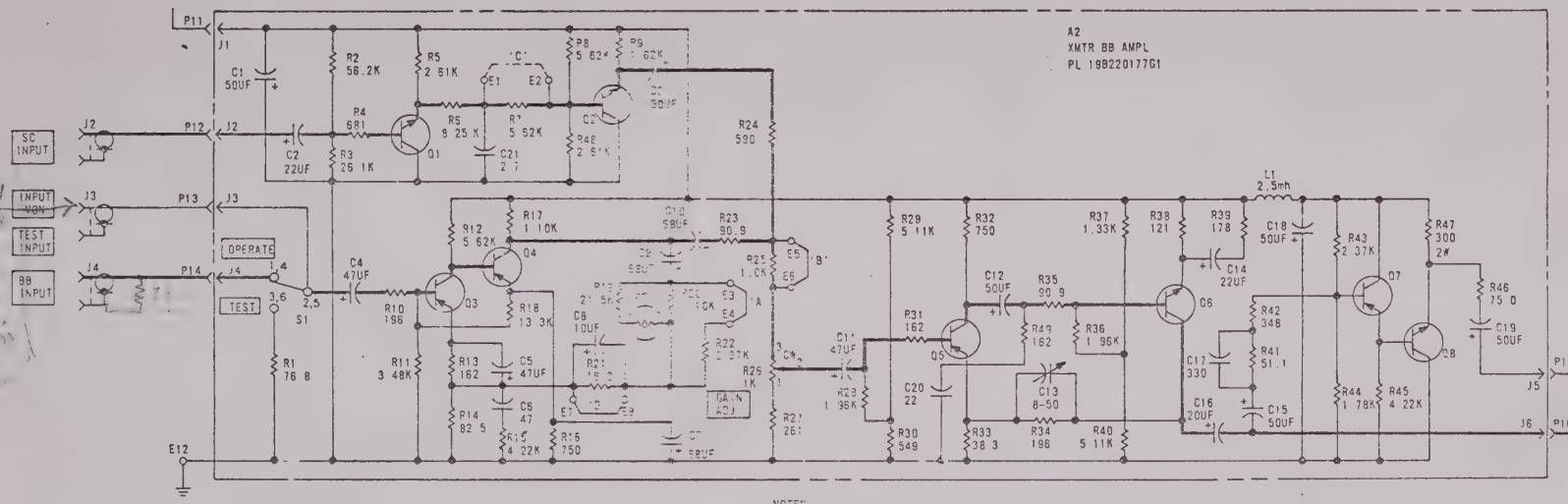
S1

PIN IDENTIFICATION

Service Outline

TRANSMITTER BASEBAND AMPLIFIER
PL-19B220177-G1

(Drawing No. 19B220177, Rev. 2)



6 mV Test

(47 mV)

OUT. MON.

BB OUT

SEMI CONDUCTOR CHART

ITEM NO	G.E. IDENT NO.	SIMILAR TO * JEDEC REG. NO
Q1	19A116375P1	TIP 32A
Q2	19A115562P1	
A1CR1	4038056P1	
A1CR2, A1CR3	19A115250P1	SSD-753
A1VR1, A1VR2	4036887P51	
A1VR3	4C36887P53	
A1Q1	19A115562P1	
A1Q2 A1Q3 A1Q6, A1Q7	19A115852P1	2N3906
A1Q4, A1Q5	19A115362P1	
A2Q1, A2Q2	19A115910P1	2N3904
A2Q3, A2Q4, A2Q5, A2Q7	19A115852P1	2N3906
A2Q6, A2Q8	19A115591P1	2N2218A
Y1 Q1	19A103328P1	
Y1 CV1	19A116498P1	

* FOR REFERENCE ONLY NOT RECOMMENDED FOR EXACT REPLACEMENT

NOTES:

1. ALL RESISTORS ARE 1/2 WATT UNLESS OTHERWISE SPECIFIED AND RESISTOR VALUES IN OHMS UNLESS FOLLOWED BY K=1000 OHMS OR MEG=1,000,000 OHMS. CAPACITOR VALUES IN PICOFARADS (EQUAL TO MICROMICROFARADS) UNLESS FOLLOWED BY UF= MICROFARADS. INDUCTANCE VALUES IN MICROHENRYS UNLESS FOLLOWED BY MH= MILLIHENRYS OR H=HENRYS.
2. [ ] INDICATES FRONT PANEL MARKING.
3. SUBASSEMBLY REFERENCE DESIGNATION ARE ABBREVIATED. PREFIX THE DESIGNATION WITH SUB ASSEMBLY DESIGNATION.
4. FOR -45 dBm/CHANNEL INPUT REMOVE JUMPER 'A' BETWEEN A2E3 & A2E4. FOR 6.5 dB UNDER DEVIATION REMOVE JUMPER 'B' BETWEEN A2E5 & A2E6. FOR NON-EMPHASIZED LOADING ADD JUMPER 'C' BETWEEN A2E1 AND A2E2. FOR 300 Hz 0.1 dB BOOST REMOVE JUMPER 'D' BETWEEN A2E7 AND A2E8.

19D409274 GP. IDENTIFICATION

GP	Y1 RF OSC MOD	DESCRIPTION
1	19C316189G1	HIGH POWER XMTR
2	19C316189G2	LOW POWER XMTR

PARTS LIST

TRANSMITTER BASEBAND AMPLIFIER
19B220177G1

SYMBOL	GE PART NO.	DESCRIPTION
		- - - - - - - - - CAPACITORS - - - - - - - - -
C1	19A115680P6	Electrolytic: 50 µf +150% -10%, 50 VDCW; sim to Mallory Type TT.
C2	5496267P10	Tantalum: 22 µf ±20%, 15 VDCW; sim to Sprague Type 150D.
C3	19A115680P4	Electrolytic: 50 µf +150% -10%, 25 VDCW; sim to Mallory Type TT.
C4 and C5	5496267P2	Tantalum: 47 µf ±20%, 6 VDCW; sim to Sprague Type 150D.
C6	5490008P19	Silver mica: 47 pf ±5%, 500 VDCW; sim to Electro Motive Type DM-15.
C7	19A115680P4	Electrolytic: 50 µf +150% -10%, 25 VDCW; sim to Mallory Type TT.
C8	19A115680P8	Electrolytic: 10 µf +150% -10%, 25 VDCW; sim to Mallory Type TT.
C9 and C10	19A115680P4	Electrolytic: 50 µf +150% -10%, 25 VDCW; sim to Mallory Type TT.
C11	5496267P2	Tantalum: 47 µf ±20%, 6 VDCW; sim to Sprague Type 150D.
C12	19A115680P4	Electrolytic: 50 µf +150% -10%, 25 VDCW; sim to Mallory Type TT.
C13	5490446P1	Variable, ceramic: approx 8-50 pf, 350 VDCW, temp coef -750 PPM; sim to Erie Style 557-36.
C14	5496267P10	Tantalum: 22 µf ±20%, 15 VDCW; sim to Sprague Type 150D.
C15	19A115680P4	Electrolytic: 50 µf +150% -10%, 25 VDCW; sim to Mallory Type TT.
C16	19A115680P3	Electrolytic: 20 µf +150% -10%, 25 VDCW; sim to Mallory Type TT.
C17	7489162P39	Silver mica: 330 pf ±5%, 500 VDCW; sim to Electro Motive Type DM-15.
C18	19A115680P6	Electrolytic: 50 µf +150% -10%, 50 VDCW; sim to Mallory Type TT.
C19	19A115680P4	Electrolytic: 50 µf +150% -10%, 25 VDCW; sim to Mallory Type TT.
C20	7489162P11	Silver mica: 22 pf ±5%, 500 VDCW; sim to Electro Motive Type DM-15.
		- - - - - - - - - TERMINALS - - - - - - - - -
E1 thru E8	19A115296P1	Terminal, standoff: sim to Cambridge Thermionic Corp X1558-BB.
		- - - - - - - JACKS AND RECEPTACLES - - - - -
J1 thru J6	19A116361P4	Contact, electrical: sim to Malco 14A117-12.
		- - - - - - - - - INDUCTORS - - - - - - - - -
L1	7491382P109	Coil, RF: 2500 mh ±10%, 35 ohms DC res max; sim to Delevan 3500 Series.
		- - - - - - - - - TRANSISTORS - - - - - - - - -
Q1 and Q2	19A115910P1	Silicon, NPN; sim to Type 2N3904.
Q3 thru Q5	19A115852P1	Silicon, PNP; sim to Type 2N3906.
Q6	19A115591P1	Silicon, NPN; sim to Type 2N2218A.
Q7	19A115852P1	Silicon, PNP; sim to Type 2N3906.
Q8	19A115591P1	Silicon, NPN; sim to Type 2N2218A.

SYMBOL	GE PART NO.	DESCRIPTION
		- - - - - - - - - - RESISTORS - - - - - - - -
R1	19A116278P86	Metal film: 76.8 ohms ±2%, 1/2 w.
R2	19A116278P373	Metal film: 56,200 ohms ±2%, 1/2 w.
R3	19A116278P341	Metal film: 26,100 ohms ±2%, 1/2 w.
R4	19A116278P181	Metal film: 681 ohms ±2%, 1/2 w.
R5	19A116278P241	Metal film: 2610 ohms ±2%, 1/2 w.
R6	19A116278P289	Metal film: 8250 ohms ±2%, 1/2 w.
R7 and R8	19A116278P273	Metal film: 5620 ohms ±2%, 1/2 w.
R9	19A116278P221	Metal film: 1620 ohms ±2%, 1/2 w.
R10	19A116278P129	Metal film: 196 ohms ±2%, 1/2 w.
R11	19A116278P253	Metal film: 3480 ohms ±2%, 1/2 w.
R12	19A116278P273	Metal film: 5620 ohms ±2%, 1/2 w.
R13	19A116278P121	Metal film: 162 ohms ±2%, 1/2 w.
R14	19A116278P89	Metal film: 82.5 ohms ±2%, 1/2 w.
R15	19A116278P261	Metal film: 4220 ohms ±2%, 1/2 w.
R16	19A116278P185	Metal film: 750 ohms ±2%, 1/2 w.
R17	19A116278P205	Metal film: 1100 ohms ±2%, 1/2 w.
R18	19A116278P313	Metal film: 13,300 ohms ±2%, 1/2 w.
R19	19A116278P333	Metal film: 21,500 ohms ±2%, 1/2 w.
R20	19A116278P205	Metal film: 1100 ohms ±2%, 1/2 w.
R21	19A116278P21	Metal film: 16.2 ohms ±2%, 1/2 w.
R22	19A116278P237	Metal film: 2370 ohms ±2%, 1/2 w.
R23	19A116278P93	Metal film: 90.9 ohms ±2%, 1/2 w.
R24	19A116278P175	Metal film: 590 ohms ±2%, 1/2 w.
R25	19A116278P201	Metal film: 1000 ohms ±2%, 1/2 w.
R26	19A116430P5	Variable, cermet: 1000 ohms ±10%, 0.75 w.
R27	19A116278P141	Metal film: 261 ohms ±2%, 1/2 w.
R28	19A116278P229	Metal film: 1960 ohms ±2%, 1/2 w.
R29	19A116278P269	Metal film: 5110 ohms ±2%, 1/2 w.
R30	19A116278P172	Metal film: 549 ohms ±2%, 1/2 w.
R31	19A116278P121	Metal film: 162 ohms ±2%, 1/2 w.
R32	19A116278P185	Metal film: 750 ohms ±2%, 1/2 w.
R33	19A116278P57	Metal film: 38.3 ohms ±2%, 1/2 w.
R34	19A116278P129	Metal film: 196 ohms ±2%, 1/2 w.
R35	19A116278P93	Metal film: 90.9 ohms ±2%, 1/2 w.
R36	19A116278P229	Metal film: 1960 ohms ±2%, 1/2 w.
R37	19A116278P213	Metal film: 1330 ohms ±2%, 1/2 w.
R38	19A116278P109	Metal film: 121 ohms ±2%, 1/2 w.
R39	19A116278P125	Metal film: 178 ohms ±2%, 1/2 w.
R40	19A116278P269	Metal film: 5110 ohms ±2%, 1/2 w.
R41	19A116278P69	Metal film: 51.1 ohms ±2%, 1/2 w.
R42	19A116278P153	Metal film: 34.8 ohms ±2%, 1/2 w.
R43	19A116278P237	Metal film: 2370 ohms ±2%, 1/2 w.
R44	19A116278P225	Metal film: 1780 ohms ±2%, 1/2 w.
R45	19A116278P261	Metal film: 4220 ohms ±2%, 1/2 w.
R46	19A116278P85	Metal film: 75.0 ohms ±2%, 1/2 w.
R47	3R79P301J	Composition: 300 ohms ±5%, 2 w.
R48	19A116278P241	Metal film: 2610 ohms ±2%, 1/2 w.
R49	19A116278P121	Metal film: 162 ohms ±2%, 1/2 w.
		- - - - - - - - - THERMISTORS - - - - - - - - -
RT1	5490828P11	Thermistor: 50,000 ohms ±10%, color code yellow; sim to Globar Type 783F-5.

*COMPONENTS ADDED, DELETED OR CHANGED BY PRODUCTION CHANGES

SYMBOL	GE PART NO.	DESCRIPTION
		- - - - - - - - - - SWITCHES - - - - - - - - - -
S1	19A115004P1	Slide: DPDT, 200 VDC at 15 ma, 12 VDC at 30 ma; sim to Oak Mfg 19640509.
		- - - - - - - - - MISCELLANEOUS - - - - - - - - -
	4036555P1	Insulator, washer: nylon. (Used with Q6, Q8).
	19A115580P1	Heat sink. (Used with Q6, Q8).

PRINCIPLES OF OPERATION

TRANSMITTER AFC AMPLIFIER PL-19C306568-G2

GENERAL

The AFC Amplifier Unit contains the circuitry that supplies the crystal reference and AFC meter circuit drive voltages and the amplifier and detector circuit that converts frequency error signal from the crystal reference source to an AFC control voltage that is applied to the transmitter oscillator. The unit is constructed on a printed wire board and is plugged into the bottom slot on back of the transmitter door.

SPECIFICATIONS

Input voltage:	-24 Vdc
Drive output:	-5.5 ±0.5 V square wave reference to ground
AFC input:	Square wave error from AFC reference source, 40 mV/MHz
AFC output:	Control of oscillator varactor voltage Static: 11.5 Vdc Control Range: ±9.5 Vdc

CIRCUIT DESCRIPTION

The transmitter AFC amplifier circuit is described in four parts: (1) input voltage circuit, (2) drive circuit, (3) amplifier and detector circuit, and (4) metering circuit. Refer to Elementary Diagram 19D409245.

INPUT VOLTAGE CIRCUIT

Negative 24 Vdc is applied to contact A. This voltage supplies the operating potentials for the amplifier and detector circuit, and the input voltage for the circuit that supplies the reference drive, meter drive and reference voltages for the detector. The amplifier and detector circuit is comprised of transistors Q1 through Q10. The input to the drive and reference voltage circuit consists of transistors Q11 and Q12 and windings on transformer T2.

Input voltage is applied to transistors Q11 and Q12 and windings on saturable core transformer T2 through R39. The two transistors alternately switch from a cutoff to a conducting state, thereby drawing current through each half of the center-tapped winding in their collector circuits in alternate succession. Suppose Q12 begins to conduct. The transistor draws current through winding 1-3, and a positive potential is induced in the other windings as indicated by the dots on the Elementary Diagram. Q12 is driven further into the conducting state due to the build-up of positive potential at its base, Q11 is cutoff due to the build-up of negative potential at its base, and the core of T2 starts toward saturation. When core saturation is reached, the magnetic field collapses. This causes a reversal of the potentials induced in the windings which is sufficient to start Q11 conducting, Q12 to cutoff and the core of T2 to start toward saturation again. The voltages induced in the secondary windings of T2 are those from which the drive and reference voltages are derived.

Both the 70 MHz reference oscillator and transmitter crystal AFC receiver are periodically switched by the voltage provided by the AFC output. This circuit consists of winding 12-14 on T2, transistor Q13, zener diode VR1 and voltage divider R40-R41.

Negative 24 Vdc is applied to VR1 through R48-R49. This voltage is chopped by Q13 which is turned on and off in alternate succession by the voltage applied to its base from winding 12-14. The output of the circuit, taken from divider R40-R41, is essentially a square wave voltage of constant amplitude. This voltage is taken from the unit at contact 3.

AMPLIFIER AND DETECTOR CIRCUIT

The transmitter crystal AFC provides the frequency error signal to the AFC amplifier. This is a square wave voltage whose amplitude is a function of the amount of deviation from the assigned transmitter frequency and which, depending on the direction of deviation relative to the assigned frequency, is either inphase or 180^{o} out-of-phase with a reference voltage supplied by winding 9-10 of transformer T2. The error signal is amplified and applied to a detector which compares its phase to that of the reference voltage and produces a dc voltage of the amplitude and polarity required to put the transmitter back on the assigned frequency.

The frequency error signal is applied at contact E, and is coupled to the base of Q1 via gain control R3 and capacitor C1. Transistors Q1, Q2, Q4, Q5, and Q6 form a five-stage amplifier. Gain control R3 is used to set AFC loop gain. Error signal from the collector of Q2 is connected to the AFC ERROR test point on the AFC control panel through C8 and contact D. A switch, located on the AFC control panel, is connected between the output of Q5 and the input of Q6 by contacts C and 6. The AFC loop is open when this switch is in its AFC SET position, and closed when it is in its AFC ON position. The output of transistor Q6 is connected into the detector circuit.

The detector circuit is comprised of transistors Q7 through Q10, transformer T1, and the bridge rectifier formed by diodes CR1 through CR4. The four transistors are connected into a bridge circuit that is connected to an eleven volt source formed by R34 and VR3. Transistors Q9 and Q10 are turned on and off in alternate succession by the reference voltage from winding 9-10 on T2. Error signal is connected from Q6 to the base of Q7 and Q8. When there is no error signal, Q7 and Q8 provide a low impedance return for T1 and the voltage across the primary of T1 is the eleven volts (peak-to-peak) switched into it by Q9 and Q10. When error signal is present at the bases of Q7 and Q8, it either increases or decreases the voltage across the primary of T1 by an amount depending on its amplitude and its phase relative to the reference voltage applied to Q9 and Q10. The circuit is arranged so that the voltage across the primary of T1 will be reduced when error signal and reference voltage are in phase, and increased when they are out of phase. The voltage induced in the secondary of T1 is rectified by bridge rectifier CR1 through CR4. The filtered output of the rectifier appears across R54. This is the AFC control voltage that is connected in series with the varactor voltage adjust pot (through contacts 12 and 15), to move the transmitter oscillator back on frequency. The quiescent value of this voltage is about 11.5 Vdc and it can vary the varactor voltage in excess of $\pm$9.5 Vdc.

METERING CIRCUIT

When the meter selector switch on the transmitter door is in its AFC position, one side of the meter (located on the rack meter panel) is connected to a dc voltage and the other is connected to an amplifier and a chopper in the AFC Amplifier Unit. This circuit is shown in simplified form in Figure 1.

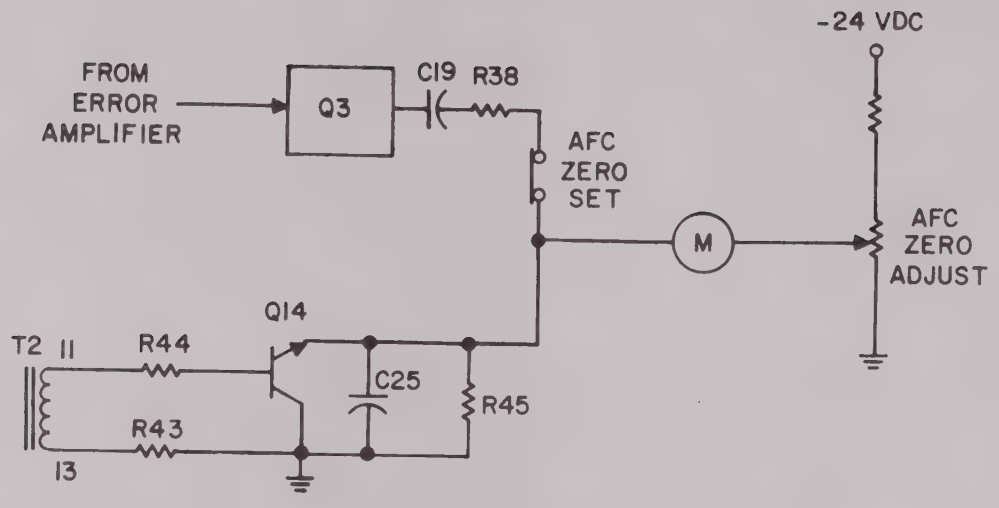


Figure 1. AFC Meter Circuit

Transistor Q3 is an amplifier that receives its input from the collector of Q5 in the error amplifier circuit. The output of Q3 is connected to the chopper circuit through C19, R38, contacts 2 and 4 and the AFC ZERO SET switch located on the transmitter door.

Transistor Q14 is a chopper which is driven by winding 11-13 on transformer T2. One side of the meter and, when the AFC ZERO SET switch is in its normally closed position, the output of Q3 is connected across chopper load resistor R45.

The AFC ZERO SET switch is grounded through Q14 when it is turned on, and through R45 when Q14 is turned off. The AFC ZERO ADJUST control is then set to obtain a reading of zero on the lower meter scale.

When the AFC ZERO SET switch is in its normally closed position, the output of Q3 appears across chopper load resistor R45. If the output of Q3 is going positive each time Q14 is turned on and negative each time Q14 is turned off, only the negative going portion of the output of Q3 will appear across R45. Conversely, when the output of Q3 is going negative each time Q14 is turned on and positive each time Q14 is turned off, only the positive going portion of the output of Q3 will appear across R45. The average voltage across R45, which is applied to one side of the meter, will be either in series aiding or series opposition to the dc voltage applied to the other side of the meter from the AFC ZERO ADJUST control. Depending on the phase of the error signal at the output of Q3 relative to the chopper bias furnished by winding 11-13 on T2, the meter will read up-scale or down-scale from its zero center position by an amount proportional to the amplitude of the error signal. When the AFC is operating properly and the transmitter is being held on frequency, the meter will read zero on its lower scale.

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MAINTENANCE

TRANSMITTER AFC AMPLIFIER UNIT
PL-19C306568-G2

GENERAL

Bench maintenance procedures for the transmitter AFC unit consist of: (1) voltage measurements, (2) amplifier and detector operation, and (3) meter circuit operation. Typical values of ac and dc voltages to be expected at selected points provide a good indication of the operation of each stage. The voltage readings given are peak-to-peak values measured with an oscilloscope. Crystal AFC and meter drive voltage measurements form a part of the voltage checks. The operation of the AFC amplifier and detector circuits is checked with (1) a positive error voltage applied and (2) a negative error voltage applied. The meter circuit is checked using a reference drive voltage which causes the indicator to deflect upscale by 2 ±1 major divisions.

A regulated negative 24 ±0.5 Vdc source voltage at 150 milliamperes is required.

Refer to Elementary Diagram 19D409245 and to Service Outline 19B220663. The Service Outline may be used for the location and identification of controls, E pins, and components. The test setup required is illustrated in Figure 1.

TEST EQUIPMENT

The items of test equipment required (or their equivalent) for maintenance of the transmitter AFC unit is listed in Table I.

TEST EQUIPMENT	MODEL	REQUIREMENT
Meter (General Electric	GE-19A115908	
Oscilloscope (Tektronix)	531	
Power Supply (Hewlett-Packard)	721A	-24 Vdc regulated at 150 mA.
Transformer (General Electric)	GE-19C307024P1	
DC Voltmeter (Hewlett-Packard)	412A	

Table I. Test Equipment Required.

MAINTENANCE PROCEDURES

AC-DC Voltage Measurements:

(1) Connect test equipment as shown in Figure 1.

(2) Set R3 on transmitter AFC unit fully clockwise.

NOTE

Unless otherwise indicated, all switches in the test setup are positioned as specified below for all voltage measurements.

(3) Make the following switch settings on the test setup: switch S1 open, switch S2 to position 2, switch S3 open, and switch S4 closed.

(4) Using a dc voltmeter and an oscilloscope, check voltage at the points listed in Table II. All dc voltage readings are negative with respect to ground.

VOLTAGE TEST	CONDITIONS	DC VOLTAGE (Negative)	VOLTAGE TEST	AC VOLTAGE (peak-to-peak)
Q1-C		17 ± 1	Q11-C, Q12-C	40 ± 4
Q2-C		14 ± 2	Q13-E	6.1 ± 0.5
Q3-C		2.0 ± 1	Q14-E	0.2 ± 0.1
Q4-C		14.3 ± 1	junction C27-R50	5.5 ± 0.5
Q5-C		10.5 ± 2	NOTE Close S3 and set S2 to position 1 for remaining voltage measurements. Set AFC error voltage to 2.5 mV p-p at TP1.	
Q6-C		5.9 ± 1		
junction R34-R35		11 ± 0.6	Q2-C	0.05 ±0.03
Across R57		18 ± 1	Q3-C	2.3 ± 0.5
Across R57	S3 closed	35 ± 2	Q5-C	1.7 ± 0.4
Across R57	S3 closed S2-pos. 1	1.9 ± 1.3	Q6-C Q7-E, Q8-E	12 ± 2 10 ± 2
			Q9-E, Q10-E	12 ± 2

Table II. Voltage Measurements (Typical)

AFC Amplifier and Detector Operation:

(1) Make the following switch settings on the test setup: switch S1 open, switch S2 to position 1, switch S3 open, and switch S4 closed.

(2) Set R3 on transmitter AFC unit fully clockwise.

(3) Measure and record the AFC output voltage across R54. This voltage should be 11.5 ± 0.5 Vdc.

(4) Close S3 on the test setup, and set AFC error voltage to 2.5 millivolt peak-to-peak (square wave) at TP1.

(5) Measure the AFC output voltage across R54. This voltage should now be at least 9.5 volts less than that recorded in Step 3.

(6) Set S2 to position 2 on the test setup, and measure the AFC output voltage across R54. This voltage should now be at least 9.5 volts more than that recorded in Step 3.

Meter Check:

(1) Zero the meter on the test setup using the zero adjust control.

(2) Set the AFC error voltage to 5 millivolts peak-to-peak at TP1.

(3) Close switch S1 on the test setup.

(4) The meter should deflect upscale 2 ± 1 large divisions.

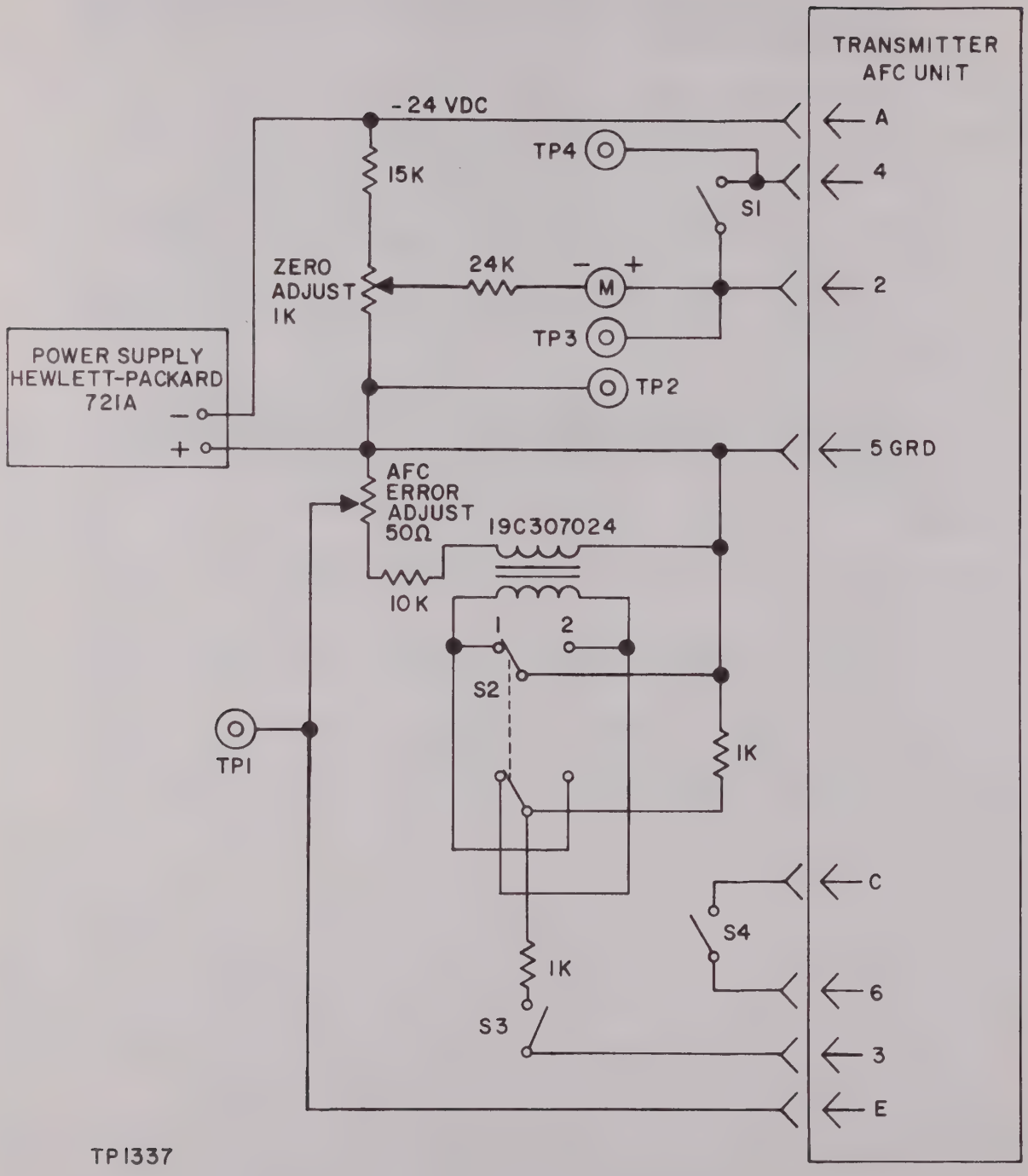

Figure 1. Transmitter AFC Unit, Test Setup

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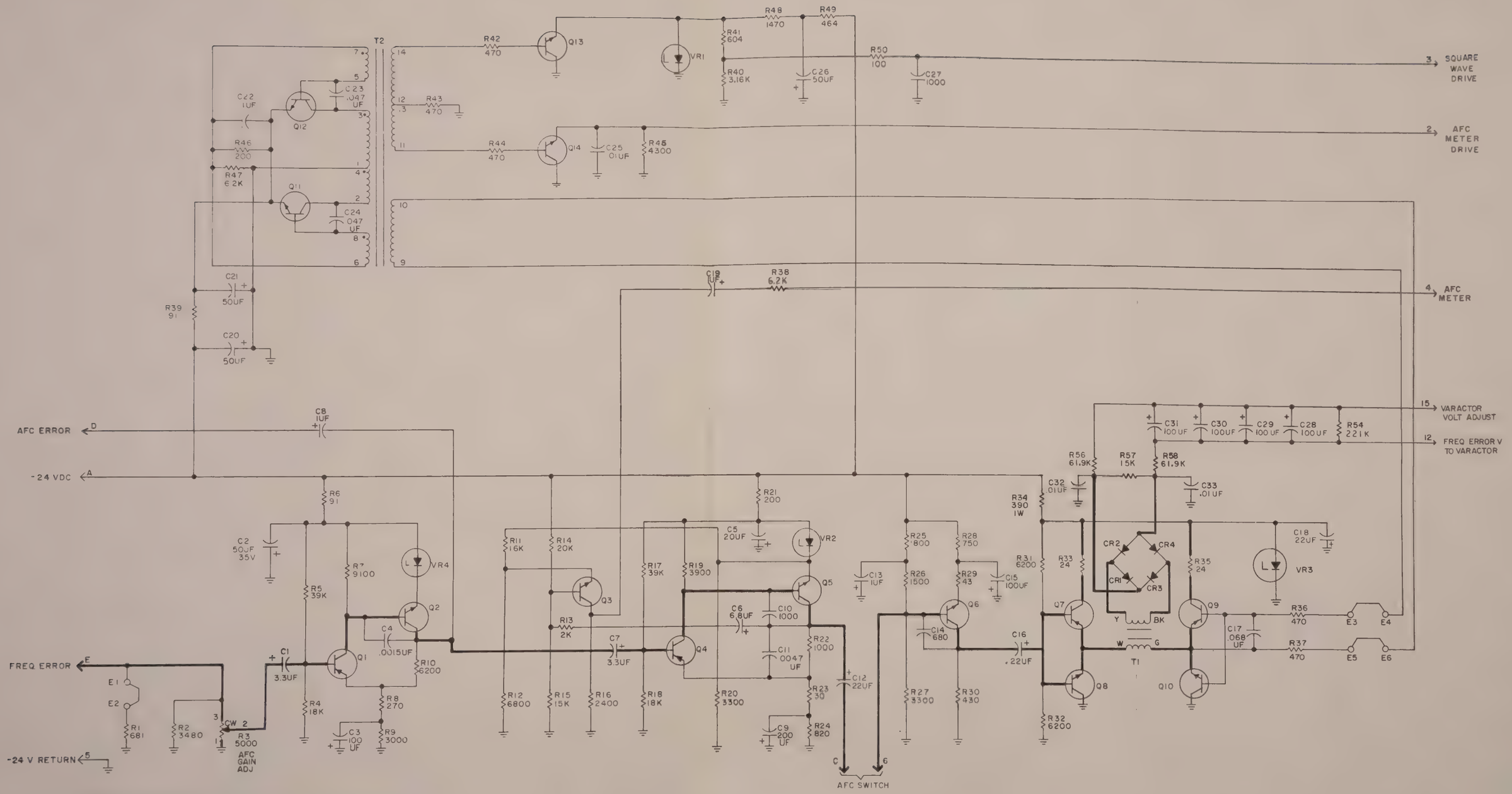


SEMI-CONDUCTOR CHART

ITEM NO.	GE IDENT NO.	SIMILAR TO JEDEC REG. NO. *
Q1,Q4,Q7 AND Q9	19A115852P1	2N3906
Q2,Q3,Q5,Q8,Q10 & Q13	19A115910 P1	2N3904
Q6	19A300114P1	2N 706
Q14	19B200065P1	2N 1302
Q11 AND Q12	19A115300P1	2N5053
CR1,CR2,CR3 AND CR4	A4037822P1	
VR2,VR4	A4036887P6	
VR3	4036887P55	

* FOR REFERENCE ONLY NOT RECOMMENDED FOR EXACT REPLACEMENT.

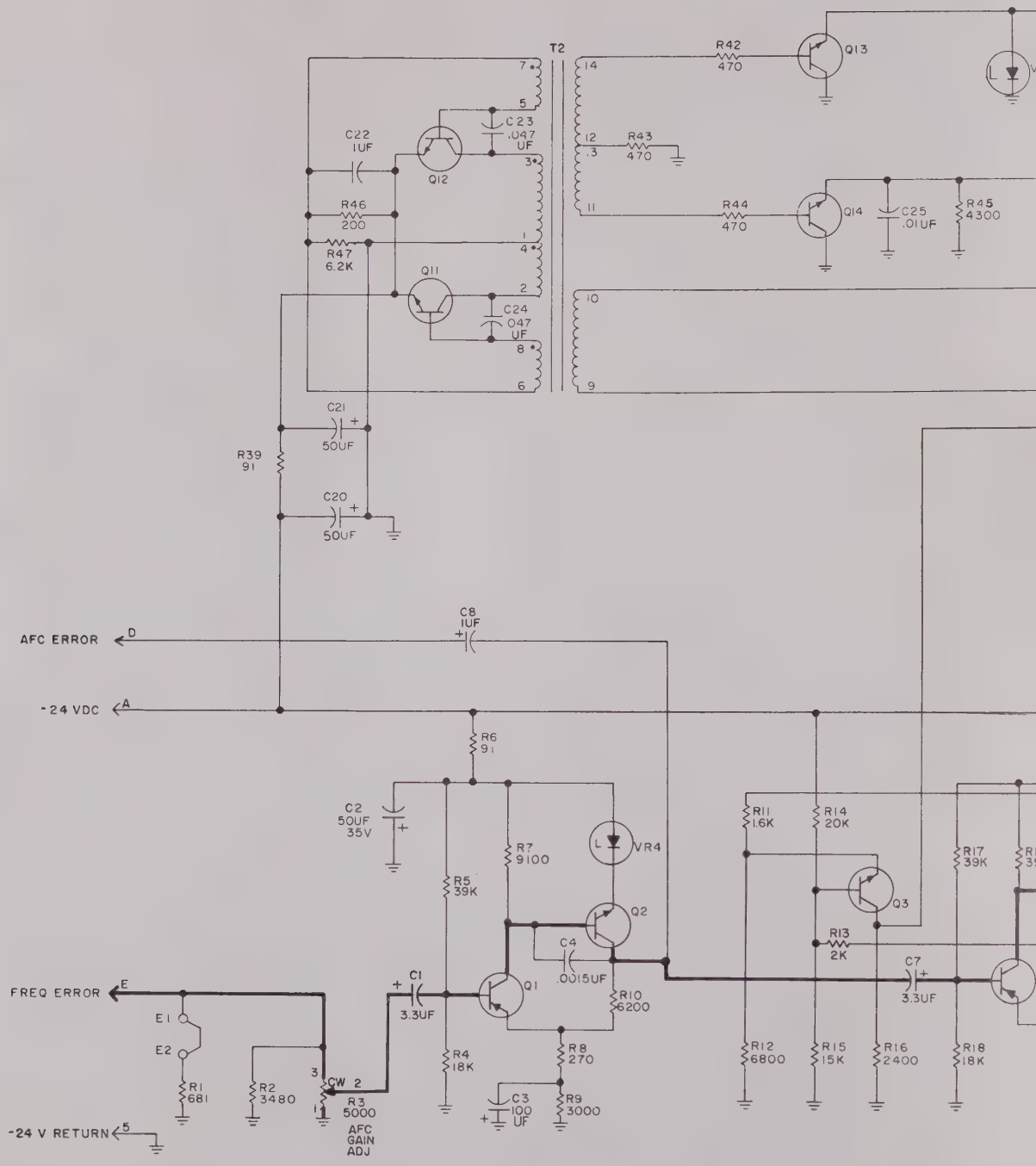
NOTES:

1. ALL RESISTORS ARE ½ WATT UNLESS OTHERWISE SPECIFIED AND RESISTOR VALUES IN OHMS UNLESS FOLLOWED BY K=1000 OHMS OR MEG=1,000,000 OHMS. CAPACITOR VALUES IN PICOFARADS (EQUAL TO MICROMICROFARADS) UNLESS FOLLOWED BY UF=MICROFARADS. INDUCTANCE VALUES IN MICROHENRYS UNLESS FOLLOWED BY MH=MILLIHENRYS OR H=HENRYS.

Elementary Diagram

TRANSMITTER AFC AMPLIFIER
PL-19C306568-G2

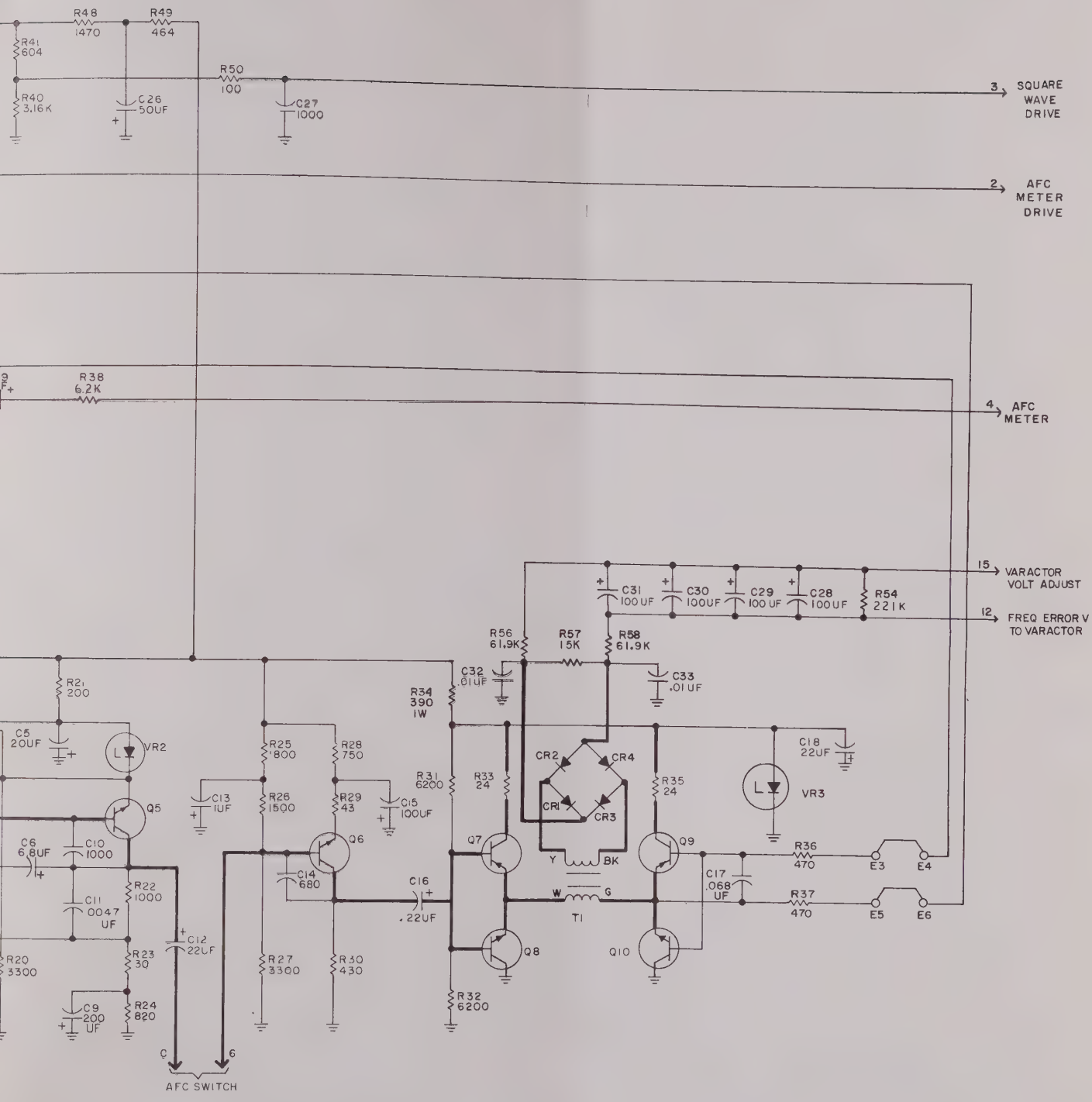
(Drawing No. 19D409245, Rev. 1)



SEMI-CONDUCTOR CHART

ITEM NO.	GE IDENT NO.	SIMILAR TO JEDEC REG. NO *
Q1,Q4,Q7 AND Q9	19A115852P1	2N3906
Q2,Q3,Q5,Q8,Q10 & Q13	19A115910 P1	2N3904
Q6	19A300114 P1	2N706
Q14	19B200065P1	2N1302
Q11 AND Q12	19A115300P1	2N5053
CR1,CR2,CR3 AND CR4	A4037822P1	
VR2,VR4	A4036887P6	
VR3	4036887P55	

* FOR REFERENCE ONLY NOT RECOMMENDED FOR EXACT REPLACEMENT.



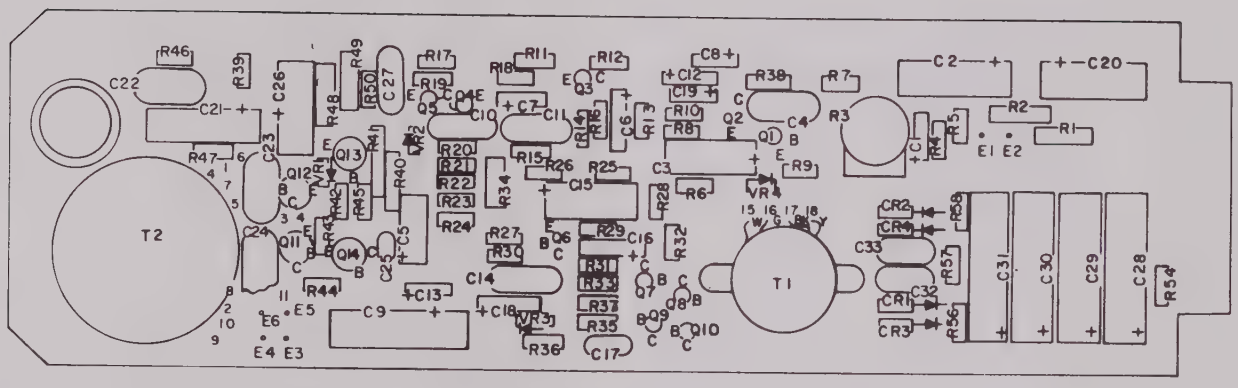
NOTES:

1. ALL RESISTORS ARE ½ WATT UNLESS OTHERWISE SPECIFIED AND RESISTOR VALUES IN OHMS UNLESS FOLLOWED BY K—1000 OHMS OR MEG—1,000,000 OHMS. CAPACITOR VALUES IN PICOFARADS (EQUAL TO MICROMICROFARADS) UNLESS FOLLOWED BY UF—MICROFARADS. INDUCTANCE VALUES IN MICROHENRYS UNLESS FOLLOWED BY MH=MILLIHENRYS OR H - HENRYS.

Elementary Diagram

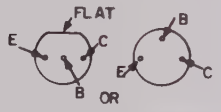
TRANSMITTER AFC AMPLIFIER
PL-19C306568-G2

(Drawing No. 19D409245, Rev. 1)



LEAD IDENTIFICATION FOR Q6, Q11, Q12 & Q14

LEAD IDENTIFICATION FOR Q1 - Q5, Q7 - Q10 & Q13



VIEW FROM LEAD END

Service Outline

TRANSMITTER AFC AMPLIFIER
PL-19C306568-G2

(Drawing No. 19B220663, Rev. 0)

PARTS LIST

TRANSMITTER AFC AMPLIFIER
19C306568G2

SYMBOL	GE PART NO.	DESCRIPTION
		- - - - - - - - - CAPACITORS - - - - - - - - -
C1	5496267P9	Tantalum: 3.3 µf ±20%, 15 VDCW; sim to Sprague Type 150D.
C2	19A115680P11	Electrolytic: 50 µf +150% -10%, 35 VDCW; sim to Mallory Type TT.
C3	19A115680P7	Electrolytic: 100 µf +150% -10%, 15 VDCW; sim to Mallory Type TT.
C4	19A115028P101	Polyester: 0.0015 µf ±20%, 200 VDCW.
C5	19A115680P3	Electrolytic: 20 µf +150% -10%, 25 VDCW; sim to Mallory Type TT.
C6	5496267P18	Tantalum: 6.8 µf ±20%, 35 VDCW; sim to Sprague Type 150D.
C7	5496267P9	Tantalum: 3.3 µf ±20%, 15 VDCW; sim to Sprague Type 150D.
C8	5496267P17	Tantalum: 1.0 µf ±20%, 35 VDCW; sim to Sprague Type 150D.
C9	19A115680P10	Electrolytic: 200 µf +150% -10%, 18 VDCW; sim to Mallory Type TT.
C10	4029003P8	Silver mica: 1000 pf ±5%, 500 VDCW; sim to Electro Motive Type DM-20.
C11	19A115028P104	Polyester: 0.0047 µf ±20%, 200 VDCW.
C12	5496267P10	Tantalum: 22 µf ±20%, 15 VDCW; sim to Sprague Type 150D.
C13	5496267P17	Tantalum: 1.0 µf ±20%, 35 VDCW; sim to Sprague Type 150D.
C14	7147203P4	Silver mica: 680 pf ±5%, 500 VDCW; sim to Electro Motive Type DM-20.
C15	19A115680P7	Electrolytic: 100 µf +150% -10%, 15 VDCW; sim to Mallory Type TT.
C16	5496267P10	Tantalum: 22 µf ±20%, 15 VDCW; sim to Sprague Type 150D.
C17	5491189P105	Polyester: 0.068 µf ±20%, 50 VDCW.
C18	5496267P10	Tantalum: 22 µf ±20%, 15 VDCW; sim to Sprague Type 150D.
C19	5496267P17	Tantalum: 1.0 µf ±20%, 35 VDCW; sim to Sprague Type 150D.
C20 and C21	19A115680P11	Electrolytic: 50 µf +150% -10%, 35 VDCW; sim to Mallory Type TT.
C22	19A115028P114	Polyester: 0.1 µf ±20%, 200 VDCW.
C23 and C24	19A115028P111	Polyester: 0.047 µf ±20%, 200 VDCW.
C25	5491189P101	Polyester: 0.01 µf ±20%, 50 VDCW.
C26	19A115680P4	Electrolytic: 50 µf +150% -10%, 25 VDCW; sim to Mallory Type TT.
C27	4029003P108	Silver mica: 1000 pf ±10%, 500 VDCW; sim to Electro Motive Type DM-20.
C28 thru C31	19A115680P5	Electrolytic: 100 µf +150% -10%, 25 VDCW; sim
C32 and C33	7774750P13	Ceramic disc: .01 µf +100% -0%, 500 VDCW.
		- - - - - - - DIODES AND RECTIFIERS - - - - - -
CR1 thru CR4	4037822P1	Silicon.
		- - - - - - - - - TERMINALS - - - - - - - - -
E1 thru E6	4033513P1	Contact, electrical: sim to Bead Chain L93-4.

SYMBOL	GE PART NO.	DESCRIPTION
		- - - - - - - - - TRANSISTORS - - - - - - - - -
Q1	19A115852P1	Silicon, PNP; sim to Type 2N3906.
Q2 and Q3	19A115910P1	Silicon, NPN; sim to Type 2N3904.
Q4	19A115852P1	Silicon, PNP; sim to Type 2N3906.
Q5	19A115910P1	Silicon, NPN; sim to Type 2N3904.
Q6	19C300114P1	Silicon, NPN.
Q7	19A115852P1	Silicon, PNP; sim to Type 2N3906.
Q8	19A115910P1	Silicon, NPN; sim to Type 2N3904.
Q9	19A115852P1	Silicon, PNP; sim to Type 2N3906.
Q10	19A115910P1	Silicon, NPN; sim to Type 2N3904.
Q11 and Q12	19A115300P1	Silicon, NPN; sim to Type 2N3053.
Q13	19A115910P1	Silicon, NPN; sim to Type 2N3904.
Q14	19B200065P1	Silicon, NPN.
		- - - - - - - - - - RESISTORS - - - - - - - - -
R1	5495948P181	Deposited carbon: 681 ohms ±1%, 1/2 w; sim to Texas Instrument CD1/2MR.
R2	5495948P253	Deposited carbon: 3480 ohms ±1%, 1/2 w; sim to Texas Instrument CD1/2MR.
R3	7491365P102	Variable, carbon film: 5000 ohms ±20%, 0.08 w; sim to CTS Type UPE-70.
R4	3R77P183J	Composition: 18,000 ohms ±5%, 1/2 w.
R5	3R77P393J	Composition: 39,000 ohms ±5%, 1/2 w.
R6	3R77P910J	Composition: 91 ohms ±5%, 1/2 w.
R7	3R77P912J	Composition: 9100 ohms ±5%, 1/2 w.
R8	3R77P271J	Composition: 270 ohms ±5%, 1/2 w.
R9	3R77P302J	Composition: 3000 ohms ±5%, 1/2 w.
R10	3R77P622J	Composition: 6200 ohms ±5%, 1/2 w.
R11	3R77P162J	Composition: 1600 ohms ±5%, 1/2 w.
R12	3R77P682J	Composition: 6800 ohms ±5%, 1/2 w.
R13	3R77P202J	Composition: 2000 ohms ±5%, 1/2 w.
R14	3R77P203J	Composition: 20,000 ohms ±5%, 1/2 w.
R15	3R77P153J	Composition: 15,000 ohms ±5%, 1/2 w.
R16	3R77P242J	Composition: 2400 ohms ±5%, 1/2 w.
R17	3R77P393J	Composition: 39,000 ohms ±5%, 1/2 w.
R18	3R77P183J	Composition: 18,000 ohms ±5%, 1/2 w.
R19	3R77P392J	Composition: 3900 ohms ±5%, 1/2 w.
R20	3R77P332J	Composition: 3300 ohms ±5%, 1/2 w.
R21	3R77P201J	Composition: 200 ohms ±5%, 1/2 w.
R22	3R77P102J	Composition: 1000 ohms ±5%, 1/2 w.
R23	3R77P300J	Composition: 30 ohms ±5%, 1/2 w.
R24	3R77P821J	Composition: 820 ohms ±5%, 1/2 w.
R25	3R77P182J	Composition: 1800 ohms ±5%, 1/2 w.
R26	3R77P152J	Composition: 1500 ohms ±5%, 1/2 w.
R27	3R77P332J	Composition: 3300 ohms ±5%, 1/2 w.
R28	3R77P751J	Composition: 750 ohms ±5%, 1/2 w.
R29	3R77P430J	Composition: 43 ohms ±5%, 1/2 w.
R30	3R77P431J	Composition: 430 ohms ±5%, 1/2 w.
R31 and R32	3R77P622J	Composition: 6200 ohms ±5%, 1/2 w.
R33	3R77P240J	Composition: 24 ohms ±5%, 1/2 w.
R34	3R78P391J	Composition: 390 ohms ±5%, 1 w.
R35	3R77P240J	Composition: 24 ohms ±5%, 1/2 w.

*COMPONENTS ADDED, DELETED OR CHANGED BY PRODUCTION CHANGES

SYMBOL	GE PART NO.	DESCRIPTION
R36 and R37	3R77P471J	Composition: 470 ohms ±5%, 1/2 w.
R38	3R77P622J	Composition: 6200 ohms ±5%, 1/2 w.
R39	3R77P910J	Composition: 91 ohms ±5%, 1/2 w.
R40	5495948P249	Deposited carbon: 3160 ohms ±1%, 1/2 w; sim to Texas Instrument CD1/2MR.
R41	5495948P154	Deposited carbon: 357 ohms ±1%, 1/2 w; sim to Texas Instrument CD1/2MR.
R42 thru R44	3R77P471J	Composition: 470 ohms ±5%, 1/2 w.
R45	3R77P432J	Composition: 4300 ohms ±5%, 1/2 w.
R46	3R77P201J	Composition: 200 ohms ±5%, 1/2 w.
R47	3R77P622J	Composition: 6200 ohms ±5%, 1/2 w.
R48	5495948P217	Deposited carbon: 1470 ohms ±1%, 1/2 w; sim to Texas Instrument CD1/2MR.
R49	5495948P165	Deposited carbon: 464 ohms ±1%, 1/2 w; sim to Texas Instrument CD1/2MR.
R50	3R77P101J	Composition: 100 ohms ±5%, 1/2 w.
R54	3R77P224J	Composition: 0.22 megohms ±5%, 1/2 w.
R56	3R77P623J	Composition: 62,000 ohms ±5%, 1/2 w.
R57	3R77P153J	Composition: 15,000 ohms ±5%, 1/2 w.
R58	3R77P623J	Composition: 62,000 ohms ±5%, 1/2 w.
		- - - - - - - - - TRANSFORMERS - - - - - - - -
T1	19B221315G1	Coil.
T2	19B203952G1	Transformer assembly.
		- - - - - - - - - VOLTAGE REGULATORS - - - - - -
VR1	19B200076P1	Silicon, Zener.
VR2	4036887P6	Silicon, Zener.
VR3	4036887P8	Silicon, Zener.
VR4	4036887P6	Silicon, Zener.
		- - - - - - - - - MISCELLANEOUS - - - - - - - -
	4036555P1	Insulator, washer: nylon. (Used with Q11, Q12, Q14).

PRINCIPLES OF OPERATION
TRANSMITTER WAVEGUIDE
PL-19B208156-G11 thru -G14

GENERAL

The TRS-696B transmitter waveguide assembly consists of transition, isolator, filter, tuner and crystal AFC subassemblies connected together to provide a path from the solid-state RF source to the waveguide stack leading to the top of the rack. Control and monitoring functions are built into some of the subassemblies.

SPECIFICATIONS

Application:

Group 11:	Basic Transmitter
Group 12:	Standby Transmitter
Group 13:	Basic Transmitter (low power)
Group 14:	Standby Transmitter (low power)

Frequency:

PSIT Band:	6.575 - 6.875 GHz

DESCRIPTION

The Group 12 and Group 14 assemblies consist of the following subassemblies (listed in order, starting at the RF source): a coax-to-waveguide transition section, an isolator, a filter, an isolator, a tuning section and an AFC section. The Group 11 and Group 13 assemblies have only one isolator (the one between the filtration and filter sections). The path from the solid-state RF source to the waveguide stack that leads to the antenna connection flange at the top of the rack, is traced in the description that follows. Refer to Service Outline 19B220791.

RF energy enters the waveguide assembly at jack J2 on the coax-to-waveguide transition section. The transition section consists of a piece of waveguide that has a flange at its open end and is closed by a short circuit plate at the other end. RF energy from the solid-state source is applied to a probe connected to J2 that is inserted into the E-plane through the wide wall of the section; it enters at a point approximately 1/4 wavelength from the short circuit plate. Three matching screws located on the oppsite wall are used to improve the match of the coaxial T. E. M. mode to the waveguide T. E. mode. A part of the power monitor circuit is built into this section of waveguide. This consists of a diode detector mount with a coupling loop that is inserted into the narrow wall of the waveguide. The output of the detector, which is developed across POWER MONITOR control R5 on the transmitter door, is a voltage proportional to transmitter output power. This is connected to the transmitter metering circuit and to the sending unit. After the transmitter has been adjusted to its maximum power output, control R5 is adjusted to

obtain a red line reading on the rack meter. The transmitter sensing unit is adjusted so it will declare a fault if the power should drop 4.5 dB.

The transition section if followed by a ferrite isolator. It is oriented so it will offer little or no attenuation (0.4 dB maximum) to energy moving out of the transition section, but 20 dB or more attenuation to energy moving back toward the transition section. This is done to prevent reflections that may originate at points beyond the transition section from reaching the solid-state source.

The isolator is followed by a three-cavity, direct coupled type of waveguide filter. It has a passband of about 25 MHz centered on the assigned transmitter frequency. In standby transmitters (waveguide assembly Group 12 or Group 14), the filter is followed by a second ferrite isolator needed to attenuate reflections at filter passband frequencies that may originate at points beyond the filter. The combined effect of two isolators separated by a filter provides 40 dB of attenuation of reflections at filter passband frequencies, and the output of the isolator is fed into the AFC section through a tuner section. The second isolator is not used in basic transmitters (waveguide assembly Group 11 or Group 13) and the output of the filter is fed into the AFC section through the tuner section.

The crystal controlled AFC section consists of reference oscillator and IF/discriminator circuits that are enclosed in a shielded container attached to the waveguide, a 70 MHz oscillator and an (optional) AFC alarm circuit enclosed in a shielded container located on the vent shelf.

A sample, taken from the transmitter energy that passes through this section to the waveguide stack that leads to the antenna connection at the top of the rack, is coupled into a mixer/multiplier diode. The mixer/multiplier diode is driven by the reference oscillator, and supplies an IF signal to the IF/discriminator where it is compared to a 70 MHz reference signal. If the two signals are at the same frequency, there is no output from the discriminator. If the frequencies are different, the discriminator output is a squarewave voltage with an amplitude that is a function of the amount of the difference. This error signal voltage is fed into the AFC amplifier where it is made into a dc voltage that is applied to the oscillator tuning varactor to correct transmitter frequency.

The AFC alarm is an optional unit used in conjunction with the crystal controlled AFC. It functions as an external alarm when the transmitter drifts beyond ± 1 MHz of its assigned frequency. It is located inside the same enclosure as the 70 MHz oscillator which is located on the vent shelf.

TELECOMMUNICATION PRODUCTS DEPARTMENT
GENERAL ELECTRIC COMPANY
LYNCHBURG, VIRGINIA

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Service Outline

TRANSMITTER WAVEGUIDE (PSIT)
PL-19B208156-G11, G12

(Drawing No. 19B220791, Rev. 0)

MAINTENANCE

TRANSMITTER WAVEGUIDE DIODE REPLACEMENT
TRS-696

1.0 GENERAL

1.0.1 Waveguide diode replacement procedures are provided for the diodes used in both the diversity and standby configurations. Included are replacement procedures for the power monitor diode and the diodes used in the transmitter waveguide switch. The transmitter waveguide switch is used only in the standby configuration; therefore, these replacement procedures are applicable only to that configuration.

1.0.2 Replacement procedures for the diodes in the AFC cavity and crystal AFC are not included. If diodes in either of these circuits become suspect during a malfunction, it is recommended that the entire assembly be removed and returned to the factory for maintenance. However, if adequate facilities are available and it is more desirable to replace the diodes in the field, the appropriate diode replacement procedures will be supplied upon special request.

1.1 DIODE REMOVAL AND REPLACEMENT PROCEDURES

1.1.1 POWER MONITOR DIODE

1.1.1.1 Refer to chaper 6 assembly drawings 19D410775 sheet 2 (diversity using AFC cavity), 19D410755 sheet 6 (diversity with crystal AFC) or to 19D410825 sheet 2 (standby) to locate power monitor jack J14. Figure 1 is a pictoral diagram of the parts comprising the diode assembly.

(1) Open transmitter door and remove the knurled cap securing P14 and J14. (It is not necessary to disconnect P14 from the knurled cap).

(2) Using a knife edge pry out on exposed lips of diode CR1 and remove diode.

(3) To install the new diode, carefully insert it into J14 until it is securely seated and then replace and tighten the knurled cap.

(4) Refer to LBI-13549 (diversity using AFC cavity) or LBI-13979 (diversity using crystal AFC), paragraph 1.4.5 and perform the transmitter power inservice checkout procedure.

1.1.2 TRANSMITTER WAVEGUIDE DIODE SWITCHES (Without Alarm Option)

1.1.2.1 Refer to chapter 6 assembly drawings 19D410825 (sheet 2) and 19B211016 to locate and identify jacks (J15 through J18) housing the waveguide diode switches used in standby configurations.

REMOVAL:

(1) Open transmitter door.

(2) Locate and identify the jack housing the defective diode and disconnect the coaxial cable. Do not loosen or remove the knurled cap securing the diode in the waveguide at this time.

(3) Using a screwdriver loosen setscrew (9) located on the opposite side of the waveguide from the knurled cap. This setscrew holds the diode holder in place and must be loosened before the diode is removed.

(4) Loosen knurled cap (1) securing the diode in the waveguide assembly and, being careful not to bump the diode against the sides of the waveguide jack, remove the diode assembly.

(5) Remove diode holder (8) and diode (7) from the jack assembly.

INSTALLATION:

(1) Carefully insert the anode end of the new diode into the diode holder (4) forming a part of the jack assembly.

(2) Insert the cathode end of the diode into the second half of the diode holder (8).

(3) Carefully insert the diode assembly into the waveguide jack and tighten the knurled cap.

NOTE

Assure that the diode is firmly seated within the diode holders by applyimg pressure with your finger against the end of the diode holder protruding from the opposite side of the waveguide. There should be no loose motion.

(4) Tighten setscrew (9) securing the diode holder.

(5) Connect coaxial cable to appropriate jack (J15-J18).

(6) Refer to Chapter 5 Section I LBI-13900 (Transfer Controller Maintenance) paragraph 3.4.1 to check the operation of the waveguide switches.

1.1.3 TRANSMITTER WAVEGUIDE DIODE SWITCHES (Crystal AFC With Alarm Option).

1.1.3.1 Refer to chapter 6 assembly drawings 19D410825 (sheet 2) and 19B211016 to locate jacks (J15 through J18) housing waveguide diode switches. Refer to figure 2 for the diode assembly diagram.

This diagram details the parts comprising the diode assembly. Various items identified in figure 2 are referenced in the following procedure.

REMOVAL:

(1) Open transmitter door.

(2) Remove power plug from J2 on the transmitter alarm assembly located near the center of the transmitter shelf.

(3) Disconnect coaxial cable from the bottom of the alarm assembly.

(4) At the lower rear of the alarm assembly remove the two Phillips head screws securing the assembly to the rack.

When removing the alarm assembly be careful not to apply any undue stress on the three connecting cables.

(5) Lift up and out on the alarm assembly and place to one side.

NOTE

When replaceing diodes housed within J15, J17, or J18 omit step 6.

(6) Using a 5/16 inch socket wrench or spin tight remove the two cap screws securing the alarm assembly mounting bracket to the rear of the rack.

(7) Locate and identify the jack housing the defective diode and disconnect the coaxial cable from the jack. Do not loosen or remove the knurled cap securing the diode in the waveguide at this time.

(8) Using a screwdriver loosen setscrew (9) located on the opposite side of the waveguide from the knurled cap. This setscrew holds the diode holder in place and must be loosened before the diode is removed.

(9) Loosen knurled cap (1) securing the diode in the waveguide assembly and, being careful not to bump the diode against the sides of the waveguide jack, remove the diode assembly.

(10) Remove diode holder (8) and diode (7) from the jack assembly.

INSTALLATION:

(1) Carefully insert the anode end of the new diode into diode holder (4) forming a part of the jack assembly.

(2) Insert the cathode end of the diode into diode holder (8).

(3) Carefully insert the diode assembly into the waveguide jack and tighten the knurled cap.

Assure that the diode is firmly seated within the diode holders by applying pressure with your finger against the end of the diode holder protruding from the opposite side of the waveguide. There should be no loose motion.

(4) Tighten setscrew (8) securing the diode holder.

(5) Connect coaxial cable to appropriate jack (J15-J18).

When replacing diodes housed within jacks J15, J17, or J18 omit step (6).

(6) Install alarm assembly bracket to rear of rack.

(7) Install alarm assembly to bracket and secure with two Phillips head screws.

(8) Connect power plug to J2 of alarm assembly.

(9) Connect coaxial cable to jack on bottom of alarm assembly.

(10) Refer to Chapter 5 Section III LBI-13900 (Transfer Controller Maintenance) paragraph 3.4.1 to check the operation of the waveguide switches.

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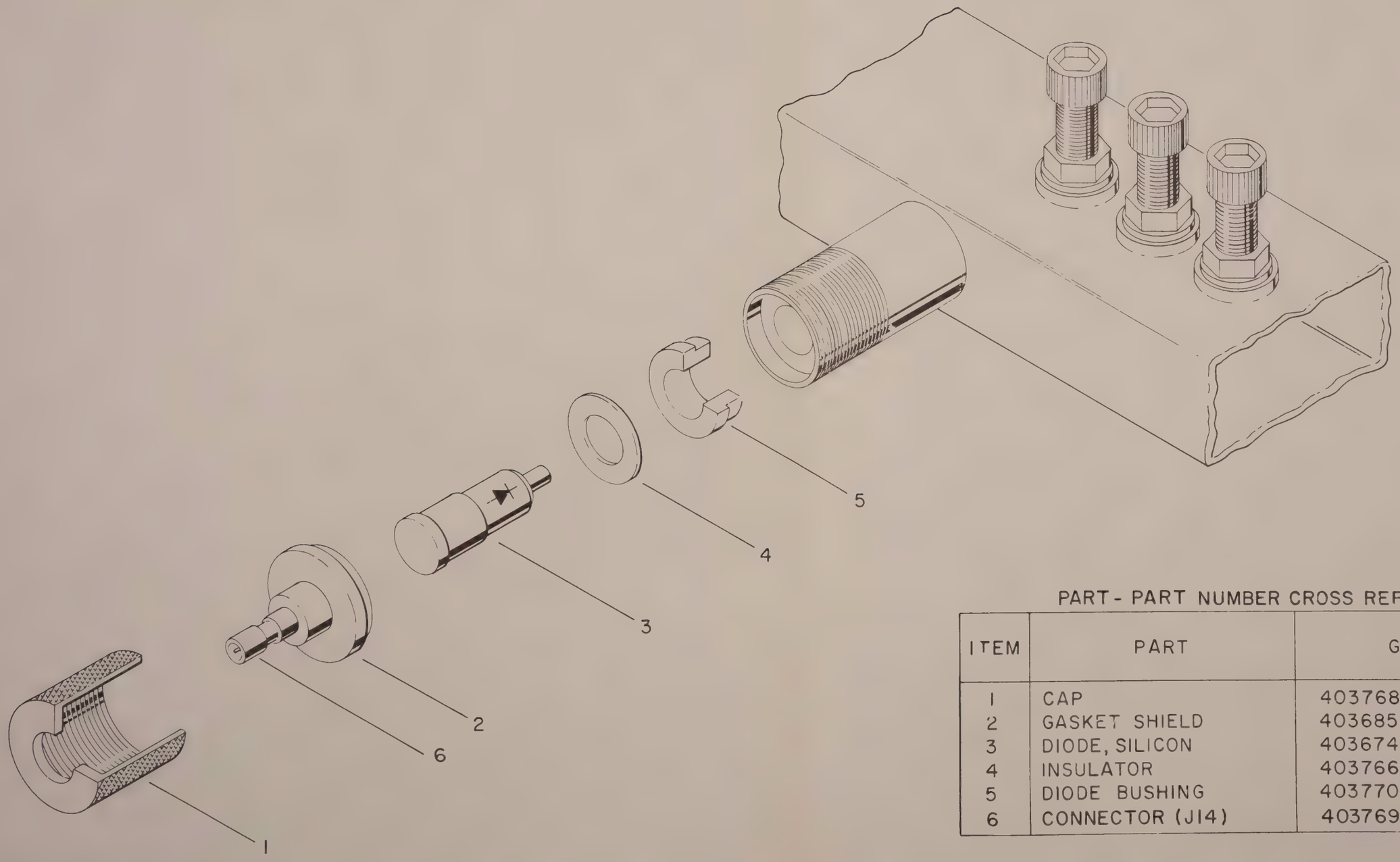


PART- PART NUMBER CROSS REFERENCE TABLE

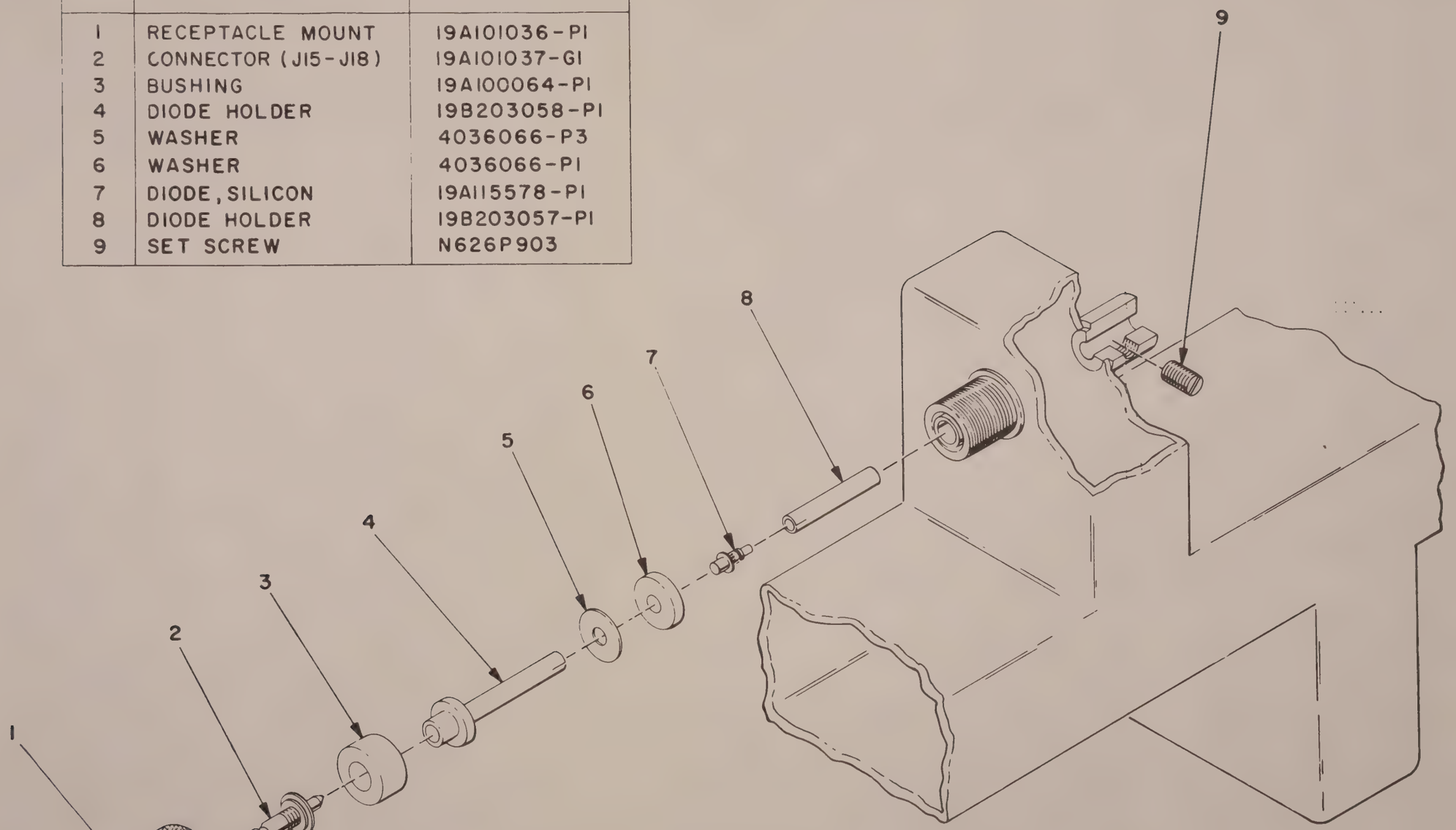
ITEM	PART	GE PART NUMBER
1	CAP	4037683-P1
2	GASKET SHIELD	4036855-P1
3	DIODE, SILICON	4036748-P1
4	INSULATOR	4037665-P2
5	DIODE BUSHING	4037703-P2
6	CONNECTOR (J14)	4037695-G2

Pictoral Diagram

POWER MONITOR DIODE ASSEMBLY
FIGURE 1

(Drawing No. 19D414135, Rev. 1)

ITEM	PART	GE PART NUMBER
1	RECEPTACLE MOUNT	19A101036-P1
2	CONNECTOR (J15-J18)	19A101037-G1
3	BUSHING	19A100064-P1
4	DIODE HOLDER	19B203058-P1
5	WASHER	4036066-P3
6	WASHER	4036066-P1
7	DIODE, SILICON	19A115578-P1
8	DIODE HOLDER	19B203057-P1
9	SET SCREW	N626P903



Pictoral Diagram

WAVEGUIDE DIODE ASSEMBLY
FIGURE 2

(Drawing No. 19D414136, Rev. 0)

RECEIVER MAINTENANCE
TRS-696

GENERAL

Receiver maintenance is divided into six major parts: (1) visual inspection, (2) identification of controls and indicators, (3) use of rack metering circuits, (4) inservice checkout procedures, (5) removal and replacement and (6) bench maintenance.

VISUAL INSPECTION

A visual inspection of the receiver should include the following:

1. When power plugs or coaxial cables are disconnected for maintenance always check for loose pins and connectors.

2. Be sure ground wire from receiver door is securely connected to rack ground bus.

3. On receiver sensing unit, assure that the flags on the printed circuit card and the mating connector on the receiver door are not damaged.

CONTROLS AND INDICATORS

The controls and indicators that are located on the front panel or are referenced in the inservice checkout and adjustment procedures are listed in figure 2-1.

CONTROL/INDICATOR	DESIGNATION	LOCATION	FUNCTION
FAULT lamp	DS2	Receiver Door	Indicates mixer current or pilot level has dropped below a preset level.
SQUELCH lamp	DS1	Receiver Door	Indicates receiver is squelched.
Meter selector	S1	Receiver Door	Selects following functions to be monitored on rack meter. 1. -24 VDC 2. +24 VDC 3. AFC 4. AGC 5. MIXER CURRENT 6. PILOT LEVEL

Figure 2-1. Controls and Indicators (Sheet 1 of 2)

CONTROL/INDICATOR	DESIGNATION	LOCATION	FUNCTION
AFC switch	S1	AFC Control Panel	Turns AFC ON or OFF and provides metering for AFC adjustment.
LO FREQ ADJ	R19	AFC Control Panel	Varies frequency control voltage to local oscillator.
BAL ADJ	R22	AFC Control Panel	Compensates for imbalances within differential amplifier.
AFC BIAS	R32	AFC Control	Varies dc level of error voltage.
FADE SIMULATOR	-	Receiver Shelf	Provides 0-50 dB attenuation in receiver path.
VOLT ADJ	R6	Local Oscillator	Sets dc voltage applied to local oscillator unit.
C29	C29	Discriminator	Adjusts receiver linearity.
Pilot receiver gain	R40	Receiver Sensing Unit	Adjusts pilot monitor circuit.
Pilot meter adjust	R55	Receiver Sensing Unit	Adjusts meter reference level.
Mixer current monitor adjust	R11	Receiver Sensing Unit	Adjusts level at which mixer fault is declared.

Figure 2-1. Controls and Indicators (Sheet 2 of 2)

USE OF METERING CIRCUITS

Six functions bearing on receiver operation can be monitored by the metering system built into the rack. By sequentially selecting each function an analysis of receiver operation can be made and generally a malfunction can be localized. These functions are listed in figure 2-2 along with their normal indications, and identification of possible faults when an obnormal indication is present.

FUNCTION	NORMAL INDICATION	POSSIBLE FAULTED UNIT
-24 VDC	Red Line ±3 small divisions	Power Supply
+24 VDC	Red Line ±3 small divisions	Power Supply
AFC	0 ±2 small divisions on bottom scale	IF Amplifier/Discriminator; AFC Unit
AGC	Up scale by an amount inversely proportional to carrier level	
MIXER CUR	Red Line	Mixer Diode; IF Preamplifier; Receiver Sensing Unit; Local Oscillator
PILOT	Red Line	Receiver Sensing Unit; Pilot Oscillator

Figure 2-2. Meter Functions and Indications

RECEIVER INSERVICE CHECKOUT AND ADJUSTMENT PROCEDURES

The inservice checkout procedures permit checkout of a receiver in diversity or working-standby configurations without interrupting traffic.

NOTE

Inservice checkout procedures cannot be performed on the basic rack without interrupting traffic.

Individual inservice checkout procedures may be performed in any sequence desired; however, if a complete checkout is to be accomplished, they should be performed in the sequence given. Prior to performing the inservice checkout procedures, assure that system traffic will not be interrupted. This is accomplished as follows:

Diversity Rack - On Diversity Controller Door set mode selector switch to A OPER when receiver B is being serviced or to B OPER position when receiver A is being serviced.

Standby Rack - On Transfer Controller Shelf set manual selector switch on receive memory unit to A operate (upper) position when receiver B is being serviced and to B operate position (lower) when receiver A is being serviced.

Test Equipment Required. The test equipment required to perform the inservice checkout procedures is listed in figure 2-3 along with the procedures to be used.

TEST EQUIPMENT	PROCEDURE				
	Receiver AFC & Local Osc. Freq.	Receiver BB Gain	Linearity & Delay	Noise Figure	Sensing Unit
Attenuator 0-50 dB			X		
Adapter TNC (M) to BNC (F)			X		
Adapter BNC "Tee"			X		
Frequency Counter, Systron Donner 1017			X		
Adapter, BNC-GE-A4037636G4			X		
Oscilloscope, Tektronix 531			X		
Test Oscillator, HP-651B					
Distortion Test Set, ITT Model 74834SC			X		
Voltmeter, ac, HP-400EL		X			
Voltmeter, dc, HP-412A	X				
Noise Tube, HP-347A				X	
Noise Figure Meter, HP-342A				X	
Termination 75 ohms	X	X			X
Test Set, GE-4UZ24A1	X	X	X		
Selective Voltmeter, Sierra 128A					X

Figure 2-3. Test Equipment Required (or equivalent)

RECEIVER AFC AND LOCAL OSCILLATOR FREQUENCY

1. Disconnect coaxial cable from J19 on door and terminate J19 in 75 ohms.

2. On receiver door, set meter selector switch to AFC.

3. Disconnect coaxial cable from J16 on receiver door and connect 50 ohm cable from OUTPUT jack on GE test set to J16.

4. Setup GE test set as follows:

(a) Set selector switch to 70 MHz.

(b) Set 10 DB ATTEN switch to IN.

5. On receiver AFC amplifier, set AFC switch to METER ZERO and adjust R1, meter zero, to obtain a mid-scale reading on rack meter.

6. Set AFC switch to RANGE position and adjust LO FREQ ADJ control for a mid-scale reading on rack meter.

7. Connect dc voltmeter across TP1 and TP2 and adjust BAL ADJ control for a null using most sensitive scale permissible.

8. Alternately adjust LO FREQ ADJ control for a mid-scale indication on rack meter and BAL ADJ control to obtain a null indication on dc voltmeter.

9. Set AFC switch to ON position and adjust AFC BIAS to obtain a mid-scale indication on rack meter.

10. Disconnect 75 ohm termination from receiver door J19 and reconnect coaxial cable disconnected in step (1).

11. Disconnect GE test set from J16 and reconnect coaxial cable to filter output.

RECEIVER BASEBAND GAIN

1. Disconnect coaxial cables from J16 and J19 on receiver door being serviced.

2. Setup GE test set as follows:

(a) Connect OUTPUT jack on GE test set to J16 on receiver door.

(b) Set 10 DB ATTEN switch to IN.

(c) Set MARKERS - DEVIATION switch to DEVIATION.

3. Connect the output of receiver door (J19) to an ac voltmeter terminated in 75 ohms.

4. Refer to inside cover of GE test set for per channel output level and check for proper meter reading. Adjust gain control R56 for specified reading.

RECEIVER LINEARITY AND DELAY (Single Rack)

1. On receiver AFC Unit, set AFC switch to RANGE position.

2. Set fade simulator to maximum position and secure with tape.

3. Select a transmitter in the same rack (out of service) to be used in conjunction with this procedure as follows:

Diversity Rack - Push attenuator plunger on selected transmitter waveguide down and block it.

Standby Rack - On transfer controller shelf set selector switch on transmitter memory unit to A operate (up) position when B transmitter is used for maintenance or to B operate (down) position when A transmitter is used for maintenance.

4. On transmitter AFC control panel, set the AFC switch to AFC SET.

5. Using a TNC to BNC adapter, connect frequency counter to local oscillator output jack J1.

6. Determine whether local oscillator frequency is tuned above or below the received carrier frequency. The received carrier frequency and the local oscillator frequency are marked on the IF preamplifier mixer assembly.

CAUTION

Exercise care when mechanically tuning local oscillator as excessive tuning between extreme ends may damage the oscillator.

7. Tune local oscillator frequency 70 MHz away from test transmitter frequency and in the same direction determined in step 6.

8. Connect test equipment as shown in figure 2-4.

9. Set receiver meter selector switch to AGC and rack meter selector switch to monitor receiver being serviced.

10. Adjust 0-50 dB attenuator for a reading of 0.3 to 0.5 on rack meter. Disconnect 304 kHz cable from LO coupling box P13-B.

11. On discriminator chassis, remove plug covering C29 and insert coupling probe connected to OUTPUT jack on GE test set.

12. Set selector switch on GE test set to 70 MHz.

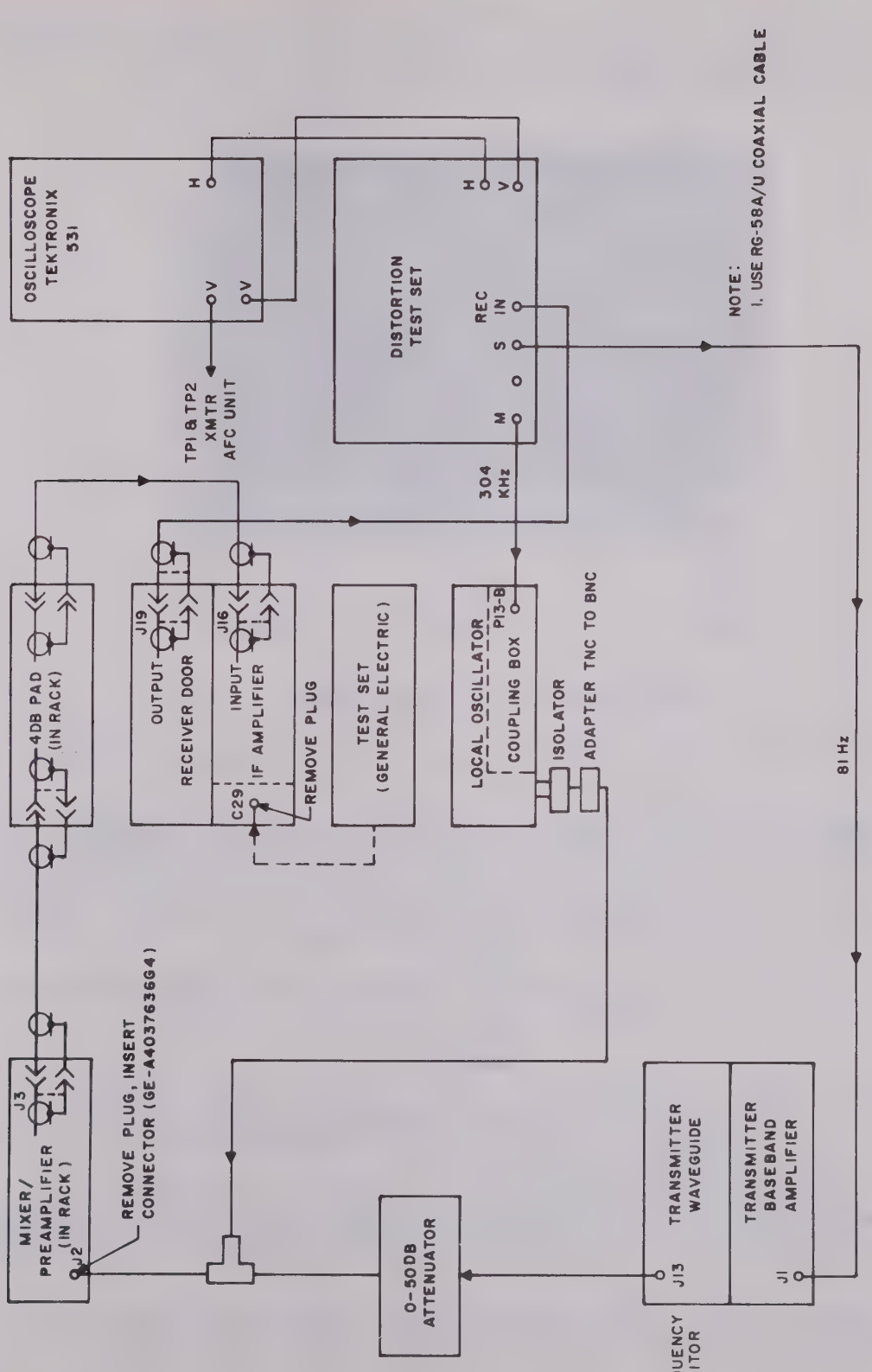


Figure 2-4. Receiver Linearity Inservice Checkout Test Setup Diagram

13. Observe oscilloscope display. Pip should appear in center of display as shown in figure 2-5. Adjust local oscillator frequency as necessary to center pip.

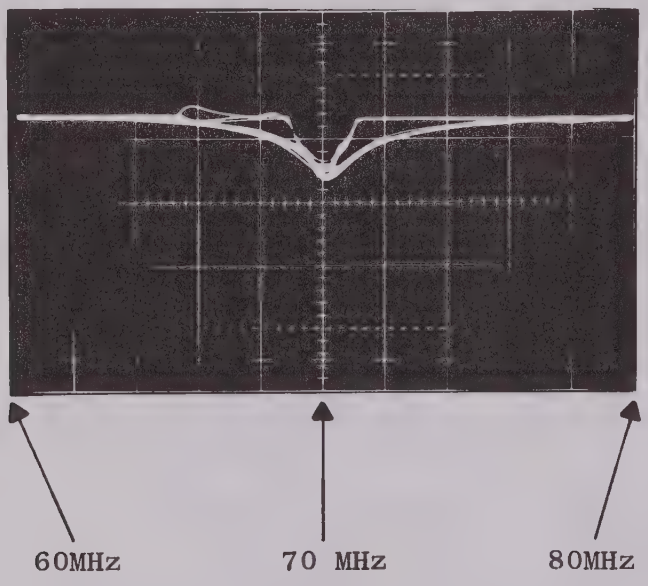


Figure 2-5. 70 MHz Pips

14. Disconnect sweep voltage from J1 of transmitter baseband amplifier.

15. Using frequency counter, monitor transmitter frequency at J13 and if necessary adjust REP ADJ control to assigned frequency.

16. Disconnect frequency counter from J13 and reconnect sweep voltage to J1 of transmitter baseband amplifier.

17. On GE test set, set selector switch to 65-75 MHz position.

NOTE

Reduce gain of receiver baseband amplifier as necessary to obtain an undistorted oscilloscope presentation.

18. On distortion test set adjust sweep voltage so that 65 and 75 MHz pips appear 2.5 cm from center of oscilloscope as shown in figure 2-6.

19. Remove GE test set coupling probe from discriminator port and reconnect 304 kHz cable to local oscillator coupling box.

NOTE

Minor tilt adjustments can be made by tuning C21. Avoid making any other adjustments to the discriminator.

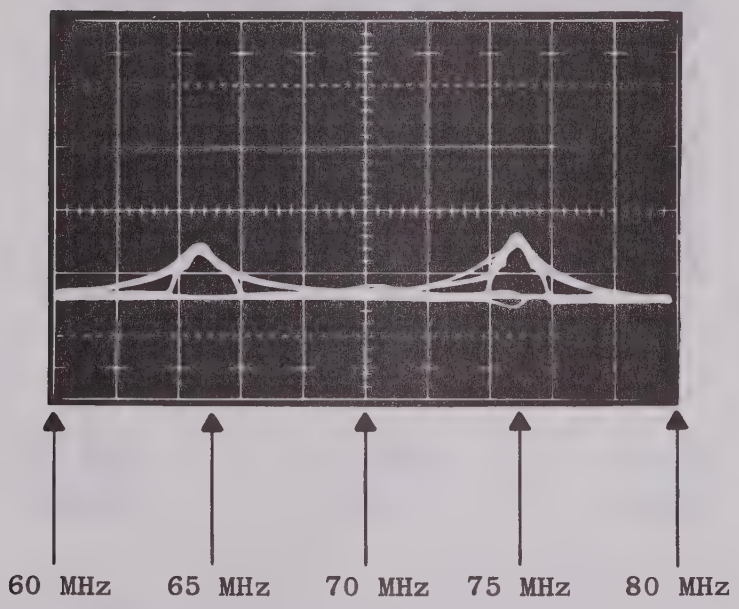


Figure 2-6. 65 and 75 MHz Pips

20. Adjust vertical gain on oscilloscope for an amplitude of 1% per centimeter. Refer to figure 2-7. If linearity is not within tolerance refer to discriminator bench maintenance procedures.

NOTE

Perform step 21 only when transmitter linearity is to be adjusted.

21. Using a grease pencil, trace the linearity curve on the oscilloscope faceplate. This provides a reference for transmitter linearity measurements.

22. On distortion test set, set controls for delay measurements of 3 nano seconds per centimeter. Calibrate vertical sweep on oscilloscope for 3 nano seconds per centimeter.

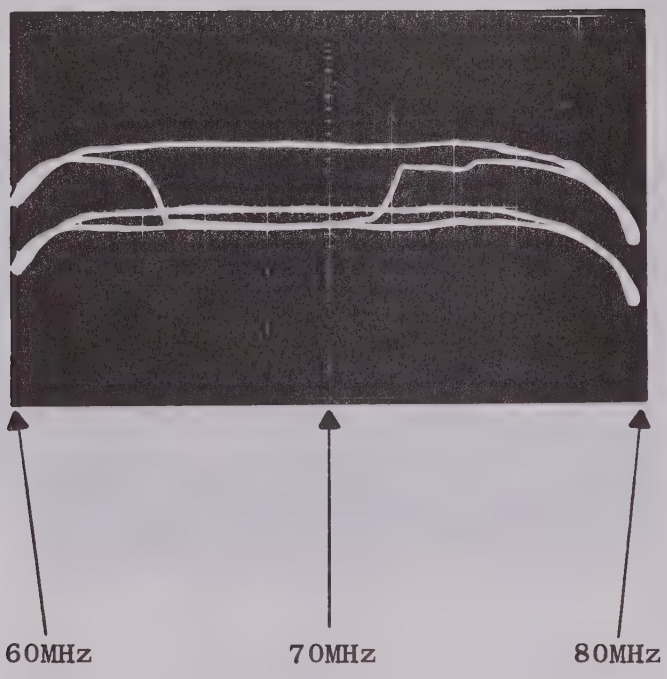


Figure 2-7. Receiver Linearity, 70 ±10 MHz, 1% cm

23. Delay (without IF filter or equalizer) should be within tolerances specified below: Refer to figure 2-8 for oscilloscope presentation.

Frequency	Min. to Max.	Asymmetry
±4 MHz	4 nano sec.	2 nano sec.
±6 MHz	8 nano sec.	4 nano sec.
±8 MHz	12 nano sec.	6 nano sec.

NOTE

If transmitter linearity measurements are to be made, refer to the TRANSMITTER MAINTENANCE instructions for the procedure.

24. Disconnect test equipment.

25 Connect frequency counter to output jack J1 on local oscillator to its original frequency.

26. Remove tape from fade simulator, release the transmitter plunger and return rack to normal operating configuration.

27. Set receiver AFC switch to ON.

28. Set transmitter AFC switch to AFC ON.

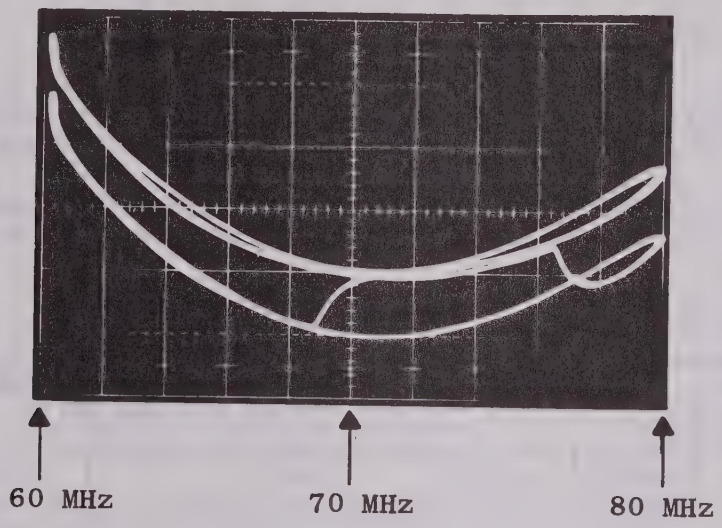


Figure 2-8. Receiver Delay

29. Refer to the RECEIVER BASEBAND GAIN procedure to adjust receiver baseband gain for proper level.

30. On Transfer Controller, set selector switch on transmitter and receiver memory units to center position.

31. On Diversity Controller, set mode selector switch to DIVERSITY OPER.

32. Perform meter check as outlined under USE OF METERING CIRCUITS.

RECEIVER NOISE FIGURE MEASUREMENT

NOTE

Measuring the receiver noise figure requires that the entire rack be taken out of service. To accurately measure noise figure it may be necessary to eliminate all 70 MHz sources.

1. Disconnect waveguide at top of rack and mount waveguide noise tube HP-347A to waveguide flange.

2. Connect waveguide noise tube to GAS TUBE jack on noise figure meter HP-342A.

3. Disconnect coaxial cable from mixer preamplifier output jack J3 on receiver shelf.

4. Using coaxial cable (RG58A/U), connect noise figure meter to mixer preamplifier output jack J3.

NOTE

Carefully read instructions for noise source prior to making noise figure measurements.

5. Noise figure should be equal to or less than the values shown in Table 2-1. If noise figure is not within limits, replace the mixer diode.

TABLE 2-1. RECEIVER NOISE FIGURE AT RACK FLAME

COMMON CARRIER* (5,925-6,425 MHz)		PSIT** (6,575-6,875 MHz)		GOVERNMENT** (7,125-8,400 MHz)	COMMON CARRIER** (10,700-11,700 MHz)
Basic Space Div. Freq. Div.	Standby	Basic Space Div.	Standby	Basic Freq. Div.	Basic Freq. Div.
10 dB	13 dB	10 dB	13 dB	11.5 dB	12.5 dB

* Includes isoduplexer loss.
** Use of isoduplexer increases noise figure by 0.4 dB.

RECEIVER SENSING UNIT

1. Terminate selective voltmeter in 75 ohms and connect to J20 on receiver baseband amplifier. Pilot level should be 19.4 millivolts ±3 millivolt for a -20 dBm receiver baseband testone output level and 13.7 millivolts ±3 millivolts for a -23 dBm receiver baseband testone output level.

2. Disconnect selective voltmeter.

NOTE

Perform remaining procedures only when fault light is on.

3. On receiver sensing unit set "pilot receiver gain ADJ" R1 and pilot meter ADJ R20 full cw. Fault light should go out.

4. Slowly turn pilot receiver gain ADJ R1 ccw until fault light just comes on.

5. Set receiver meter selector switch to PILOT.

6. On receiver sensing unit set "pilot meter ADJ" R20 for an indication of 0.60 on rack meter and then set pilot receiver gain ADJ R1 for a red line indication. Receiver is now set to fault with a 6 dB drop in pilot level.

7. Set receiver meter selector switch to MIX CUR.

8. Adjust local oscillator waveguide attenuator until meter indicates 25% of red line level.

9. On receiver sensing unit adjust mixer current monitor gain ADJ R49 until fault light just comes on.

10. Adjust local oscillator waveguide attenuator to obtain a red line indication on rack meter. Receiver FAULT light should now be out.

REMOVAL AND REPLACEMENT

GENERAL

Removal and replacement procedures are provided for replacing an entire receiver door, a subassembly, an individual circuit card, and the mixer diode. Checkout procedures to place a receiver back in service after installing a new unit are referenced.

Refer to receiver assembly drawings in Chapter 6 for location and identification of subassemblies.

Prior to removing a subassembly or circuit card from a receiver, assure that it is not in service. This is accomplished as follows:

Diversity Configuration - On Diversity Controller Door set mode selector switch to A OPER when B receiver is to be removed or to B OPER when A receiver is to be removed.

Standby Configuration - On Transfer Controller Shelf set manual selector switch on receiver logic card to A operate when B receiver is to be removed or to B operate when A receiver is to be removed.

RECEIVER DOOR

1. Open receiver door and disconnect power plug from J101, coaxial cables from jacks J16 and J19, and ground wire from ground bus inside the rack.

NOTE

The receiver door is physically mounted to the racks using interlocking pins between the doors. Refer to applicable receiver assembly drawings in Chapter 6. Do not open lower receiver door when an upper door is removed. Under these conditions it is not secured by the pins.

2. Stabilize the door with one hand and using a small screwdriver, push the guide pins upward one at a time and remove door.

3. Determine whether local oscillator frequency is above or below the received carrier frequency. The received carrier frequency and the local oscillator frequency are marked on the IF preamplifier mixer assembly.

4. On the replacement receiver door remove cover from AFC unit and check jumper connections between pins E61, E62, E63, and E68. (Refer to Service Outline Drawing 19C315290 for E pin location and identification.)

5. If local oscillator frequency is below transmitter frequency, connect jumpers between pins E61 and E62 and between pins E64 and E68.

6. If local oscillator frequency is above received frequency, connect jumpers between pins E61 and E64 and E62 and E68.

7. Replace cover on AFC unit.

8. Install new receiver door by inserting lower pin first and then depressing the upper pin. Reposition adjoining door so that upper pin locks in place.

9. On receiver door connect power plug to J101, the coaxial cables to J16 and J19, and the ground wire to rack ground bus.

10. Perform the RECEIVER BASEBAND GAIN and RECEIVER AFC AND LOCAL OSCILLATOR FREQUENCY procedures.

11. Perform meter check as outlined under USE OF METERING CIRCUITS.

12. Return rack to normal operation.

RECEIVER AFC UNIT

1. Open receiver door and disconnect power plug from J101 and coaxial cables from J16 and J19.

2. Remove eight retaining screws from receiver AFC unit and remove cover.

NOTE

Carefully label all wires that are to be disconnected from printed circuit card.

3. Unsolder coaxial cable center conductor from E46 and ground from E50.

4. Unsolder the following wires.

Color	Pin No.
White - Red	E77
Blue - Orange	E76
Red - Black	E48
Red	E47
Blue	E40

5. Remove printed circuit card from control assembly.

6. Install new AFC unit by performing removal procedures in reverse order.

7. On receiver door connect power plug to J101 and coaxial cables to J16 and J19.

8. Perform the RECEIVER AFC AND LOCAL OSCILLATOR FREQUENCY procedure.

RECEIVER BASEBAND AMPLIFIER

1. Open receiver door and disconnect power plug from J101 and coaxial cable from J19.

2. Remove seven retaining screws from cover and remove cover.

3. Label and unsolder the following wires. Refer to Service Outline 19D410719.

Wire	Pin Connection
Coaxial Cable	E24, E28, E29, E34
White	E25
Red	C3
Red	C4
Hook-up	E37
Black (3)	E31

4. Remove receiver baseband amplifier circuit card.

5. Install new circuit card. Solder wires unsoldered in step 3 and replace cover.

6. On receiver door connect power plug to J101 and connect coaxial cable to J19.

7. Perform the RECEIVER BASEBAND GAIN procedure.

RECEIVER IF AMPLIFIER/DISCRIMINATOR

1. On receiver door disconnect power plug from J101.

2. Remove eight retaining screws from cover and remove cover.

3. Refer to Service Outline 19D410719.

4. Label and unsolder wires from pins E24 and E25.

5. Unsolder and remove coupling capacitor C6 from E5 (IF amplifier) and E11 (discriminator).

6. On receiver door disconnect coaxial cable from J16.

7. Remove screws securing circuit cards and remove circuit cards.

8. Install new circuit cards by performing removal procedures in reverse order.

9. Perform the RECEIVER LINEARITY AND DELAY procedure.

RECEIVER NOISE DETECTOR

1. Open receiver door and disconnect power plug from J101.

2. Remove eight retaining screws securing cover on noise detector.

NOTE

To remove circuit card perform steps 3 through 5. To remove entire chassis, perform steps 6 through 8.

3. Refer to Service Outline Drawing No. 19B210378 Sh. 1 or Sh. 2 and unsolder L11 from E3.

4. Unsolder L6, and L9 from feed through capacitors C26 and C27 (Sh. 1); L6, L9, L10 and L12 from C26 through C29 (Sh. 2).

5. Remove three nuts securing circuit card to chassis.

6. Disconnect and remove coaxial cable from chassis stand off pin E1.

7. Label and unsolder wires from feed through capacitors C26 and C27 or from C26 through C29.

8. Remove four retaining screws securing noise detector chassis to door and remove noise detector.

9. To install new noise detector/circuit card, perform removal procedures in reverse order.

10. Perform the RECEIVER NOISE FIGURE MEASUREMENT procedure.

RECEIVER NOISE COMPARATOR

1. Open receiver door and disconnect power plug from J101.

2. Remove eight retaining screws securing cover on the noise comparator.

NOTE

To remove filter circuit card perform steps (3) through (5). To remove the noise amplifier board perform steps (6) through (8). To remove entire noise comparator assembly perform steps (9) and (10).

3. Refer to Service Outline Drawing No. 19C319330 and unsolder connection from E2 to the feed through terminal E1-A.

4. Disconnect and remove coaxial cable from stand off terminal E1 on filter card.

5. Remove four nuts securing circuit card to chassis. Remove circuit card.

6. Unsolder connection from E1 to the feed through terminal E1-B.

7. Unsolder connections from feed through capacitors C1 and C2 at E5 and E12, respectively. Unsolder connections from feed through terminals 1A through 7A at E4 and E6 through E11, respectively. Unsolder ground connection at E13.

8. Remove three nuts securing circuit board to chassis. Remove circuit card.

9. Unsolder wires connected to C1-B and C2-B and to feed through terminals 1B through 7B.

10. Remove four retaining screws securing noise comparator to door. Remove noise comparator.

11. To install new noise comparator/noise amplifier board/filter card, perform removal procedures in reverse.

12. Perform the RECEIVER NOISE FIGURE MEASUREMENT procedure.

LOCAL OSCILLATOR

1. Open receiver door and disconnect power plug from J101.

2. Disconnect power plug P13 from J13 on left rear of receiver shelf.

3. Disconnect local oscillator cable from mixer jack J2.

4. Remove coaxial cable connecting the slope equalizer to the bandpass filter.

5. Remove mounting screws securing local oscillator to shelf and together remove the oscillator coupling box and the local oscillator.

6. Disconnect BNC connector P1 between coupling box and local oscillator.

7. Remove "push-on" connector (-24 Vdc) from E1 on rear of local oscillator unit.

8. Loosen local oscillator mounting screws and remove local oscillator from coupling box.

NOTE

To install local oscillator perform steps 9 through 16.

9. Replace local oscillator unit and tighten mounting screws.

10. Connect -24 Vdc "push-on" connector to E1.

11. Connect P1 BNC connector to local oscillator.

12. Install coupling box and local oscillator assembly shelf and secure with mounting screws.

13. Connect coaxial cable between slope equalizer and bandpass filter.

14. Connect output of local oscillator to mixer input jack J2.

15. On receiver door, connect power plug to J101.

16. Use the RECEIVER AFC AND LOCAL OSCILLATOR procedure to tune the local oscillator to the correct frequency.

RECEIVER MIXER/PREAMPLIFIER REMOVAL AND REPLACEMENT

Refer to LBI-17281

MIXER DIODE REMOVAL AND REPLACEMENT

Refer to LBI-17277.

RECEIVER SENSING UNIT

The receiver sensing unit may be replaced without interrupting traffic. To remove the receiver sensing unit, open the receiver door and the hinged inner panel and remove the sensing unit circuit card. After installing the new unit, perform RECEIVER SENSING UNIT procedure.

BENCH MAINTENANCE

Bench maintenance procedures are designed to enable the technician to set up a circuit card or subassembly in a test configuration, perform a bench test checkout of the unit and to isolate a malfunction. Bench test procedures for the receiver are provided separately for each subassembly and consist of (1) Receiver Mixer/Preamplifier, (2) Local Oscillator, (3) Receiver IF Amplifier, (4) Discriminator, (5) Receiver Baseband Amplifier, (6) Receiver AFC Amplifier, (7) Noise Detector or Noise Comparator and (8) the Receiver Sensing Unit.

TELECOMMUNICATION PRODUCTS DEPARTMENT
GENERAL ELECTRIC COMPANY
LYNCHBURG, VIRGINIA

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PRINCIPLES OF OPERATION

RECEIVER WAVEGUIDE
BASIC RACK
PSIT BAND
PL-19B208481-G1 thru -G11

2.0 GENERAL

2.0.1 The TRS-696 receiver waveguide assembly used in the Basic Rack configuration consists of three waveguide sections which constitute the path for rf energy from the waveguide stack leading to the top of the rack to the mixer. The three sections are: (1) an elbow section, (2) a preselect filter section, (3) an isolator section or (optionally) a fade simulator section consisting of an isolator and a fade simulator. RF energy moves from the waveguide stack to the mixer through each section in the order listed. Refer to Drawing 19B211002.

2.1 SPECIFICATIONS

Group 1 thru 11: 6575 to 6875 MHz

2.2 DESCRIPTION

2.2.1 ELBOW SECTION

2.2.1.1 The elbow section is a piece of rectangular waveguide with an E-plane bend at one end. It is fastened to the waveguide stack at one end and to the preselect filter at a point near the bend at the other.

2.2.2 PRESELECT FILTER SECTION

2.2.2.1 The preselect filter is a seven-section bandpass filter tuned so its bandpass is centered on the assigned receiver frequency. Each section consists of posts and a tuning screw. It has a nominal bandpass of 37 MHz which is centered on the receiver frequency by adjusting the tuning screws. The preselect filter determines the image rejection and selectivity characteristics of the receiver, and is fastened to the elbow section at one end and to the isolator section or (optional) fade simulator plus isolator section at the other.

2.2.3 ISOLATOR SECTION

2.2.3.1 The isolator section consists of a piece of rectangular waveguide with two E-plane bends on which a ferrite isolator is mounted. The isolator is mounted close to the upper bend on the end fastened to the preselect filter. The ferrite isolator is based on the ferromagnetic resonance effect that results from the interaction of the magnetic field and the electrons in the ferrite material. When this resonance effect occurs, energy moving in one direction is absorbed, while energy moving in the opposite direction is affected very little. The isolator is oriented so it offers less than 0.5 dB of attenuation to signal moving into the receiver buy 20 dB or more

of attenuation to signal moving away from the receiver. The isolator assembly is fastened to the mixer section at a point beyond the lower bend.

2.2.4 FADE SIMULATOR SECTION

2.2.4.1 When the fade simulator option is selected, the fade simulator plus isolator section replaces the isolator section described previously. It consists of a rectangular piece of waveguide with two E-plane bends having a ferrite isolator mounted near the upper bend where it is fastened to the filter, and the fade simulator mounted near the lower bend where it is fastened to the mixer.

2.2.4.2 The ferrite isolator is identical to that described previously (see paragraph 2.2.3.1). The fade simulator consists of an attenuator card inside the waveguide that is fastened to a spring-loaded knob. The card is held against the waveguide wall in the normal (no attenuation) position of the knob. Attenuation increases as the card is pushed away from the wall and toward the center of the waveguide by turning the knob. Up to 50 dB of attenuation, calibrated in 5 dB increments, can be inserted in series with the incoming signal. The card is returned to its 0 dB (normal) position when the knob is released.

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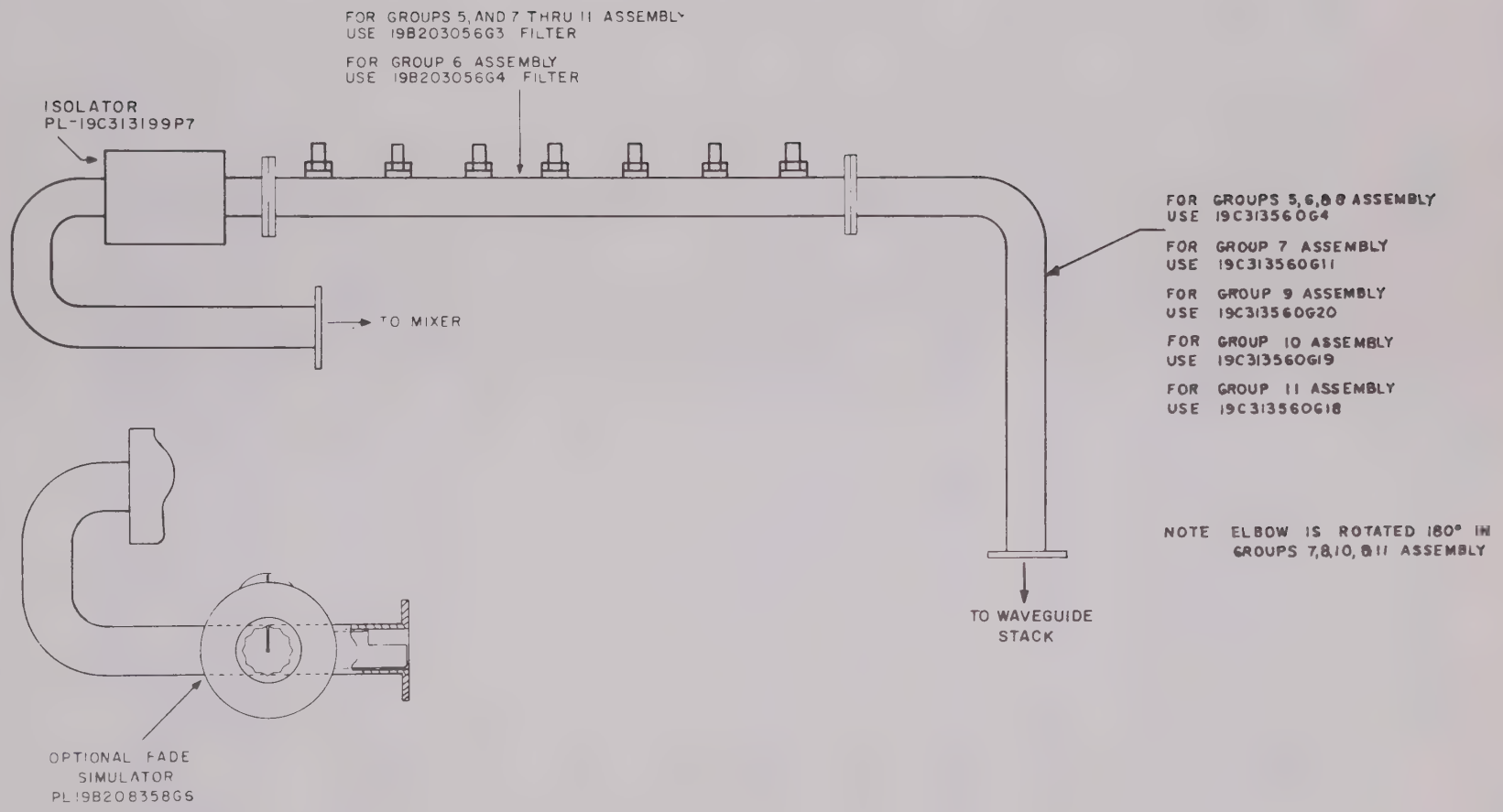

Service Outline

DIPLEXER, RCVR, BASIC
PL-19B208481-G5 thru G11

(Drawing No. 19B211002, Sh. 2, Rev. 0)

MAINTENANCE

RECEIVER WAVEGUIDE DIODE REPLACEMENT TRS-696

2.0 GENERAL

2.0.1 Waveguide diode replacement procedures are provided for the diodes used in both the diversity and standby configurations. Included are replacement procedures for the receiver mixer diode, and the diodes used in the receiver waveguide switch. The receiver waveguide switch is used only in the standby configuration; therefore, these replacement procedures are applicable only to the standby configuration. The receiver mixer diode is used in both configurations.

2.1 REMOVAL AND REPLACEMENT PROCEDURES (DIVERSITY/STANDBY)

2.1.1 RECEIVER MIXER DIODE

2.1.1.1 Refer to chapter 6 drawing 19D410709 for the receiver mixer service outline to locate the receiver mixer diode and to figure 1 for detailed diode assembly.

(1) Refer to Chapter 5 Section II, Receiver Maintenance (LBI-13580) paragraph 2.5.7 and remove local oscillator.

(2) Remove cap from diode housing (located on receiver shelf adjacent to the three tuning screws on the bottom of the receiver mixer waveguide).

(3) Using a knife edge pry down on the exposed lips of the diode and remove the diode.

(4) Carefully insert new diode being certain that it is securely seated in the diode holder.

(5) Replace cap on diode housing.

(6) Replace local oscillator removed in step 1.

(7) Refer to Chapter 5 Section II, Receiver Maintenance (LBI-13580) paragraph 2.4.5 and perform the receiver noise figure inservice checkout procedure.

2.1.2 RECEIVER WAVEGUIDE DIODE SWITCHES (STANDBY ONLY)

2.1.2.1 Refer to chapter 6 assembly drawing 19D410825 (sheet 1) to locate jack (J13) housing the waveguide diode switches. Refer to figure 2 for the diode assembly diagram. This diagram details the parts comprising the diode assembly. Various items identified in figure 2 are referenced in the following procedure.

REMOVAL:

(1) Open receiver door.

(2) Disconnect the coaxial cable from J23 (located on the right side of the receiver shelf). Do not loosen or remove the knurled cap securing the diode in the waveguide at this time.

(3) Using a screwdriver loosen setscrew (9) located on the opposite side of the waveguide from the knurled cap. This setscrew holds the diode holder in place and must be loosened before the diode is removed.

(4) Loosen knurled cap (1) securing the diode in the waveguide assembly and, being careful not to bump the diode against the sides of the waveguide jack, remove the diode assembly.

(5) Remove diode holder (8) and diode (7) from the jack assembly.

INSTALLATION:

(1) Carefully insert the anode end of the new diode into diode holder (4) forming a part of the jack assembly.

(2) Insert the cathode end of the diode into diode holder (8).

(3) Carefully insert the diode assembly into the waveguide jack and tighten the knurled cap.

NOTE

Assure that the diode is firmly seated within the diode holders by applying pressure with your finger against the end of the diode holder protruding from the opposite side of the waveguide. There should be no loose motion.

(4) Tighten setscrew (9) securing the diode holder.

(5) Connect coaxial cable to jack J23.

(6) Refer to Chater 5 Section III, Transfer Controller Maintenance (LBI-13900) paragraph 3.4.1 to check the operation of the waveguide switch.

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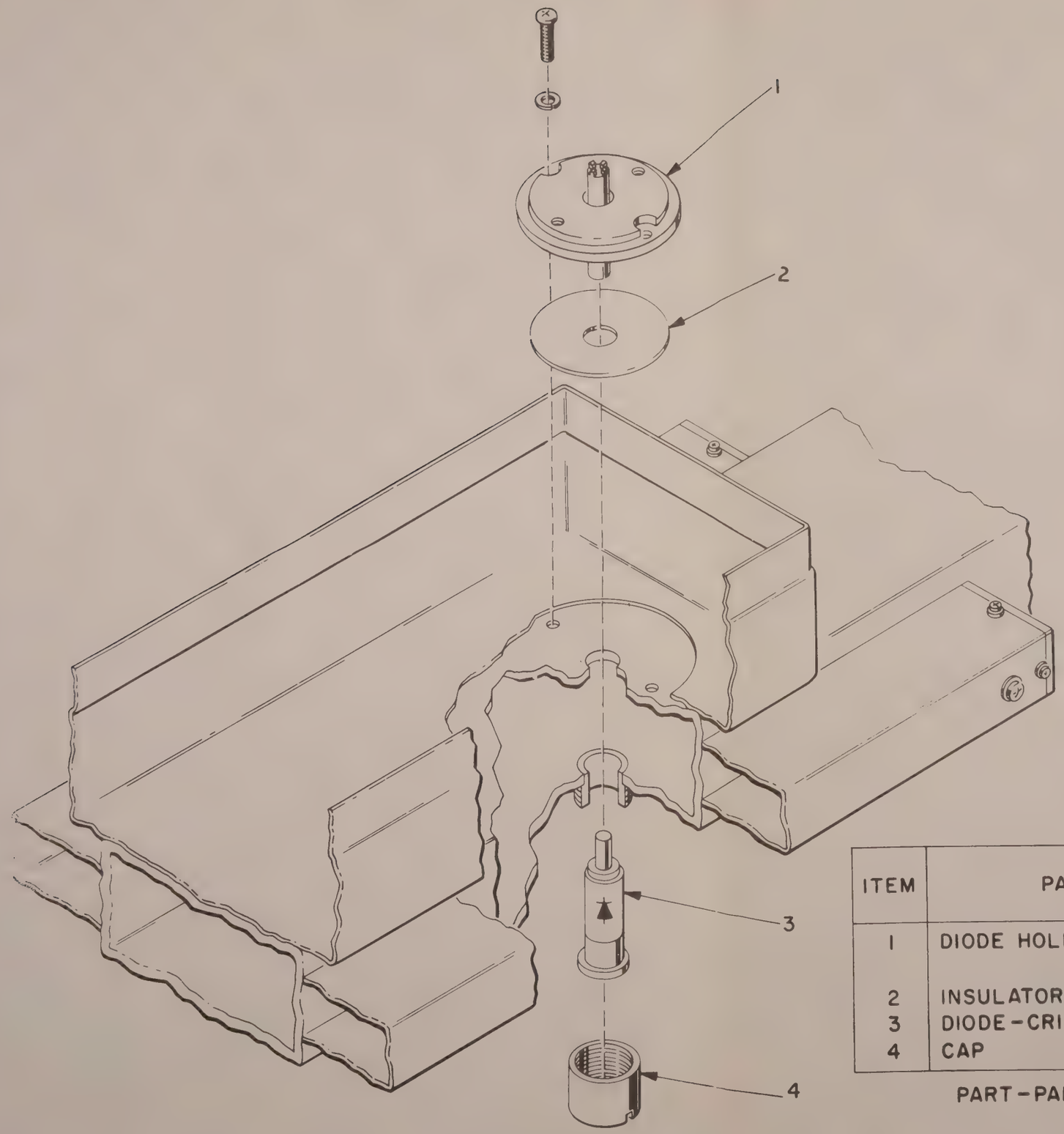


ITEM	PART	GE PART NUMBER
1	DIODE HOLDER	19A101813-P1 (GROUPS 1,2,4.5) 19A102444-P1 (GROUP 3)
2	INSULATOR	19A101814-P1
3	DIODE-CR1	4036748-P6; SILICON
4	CAP	19A101815-P1

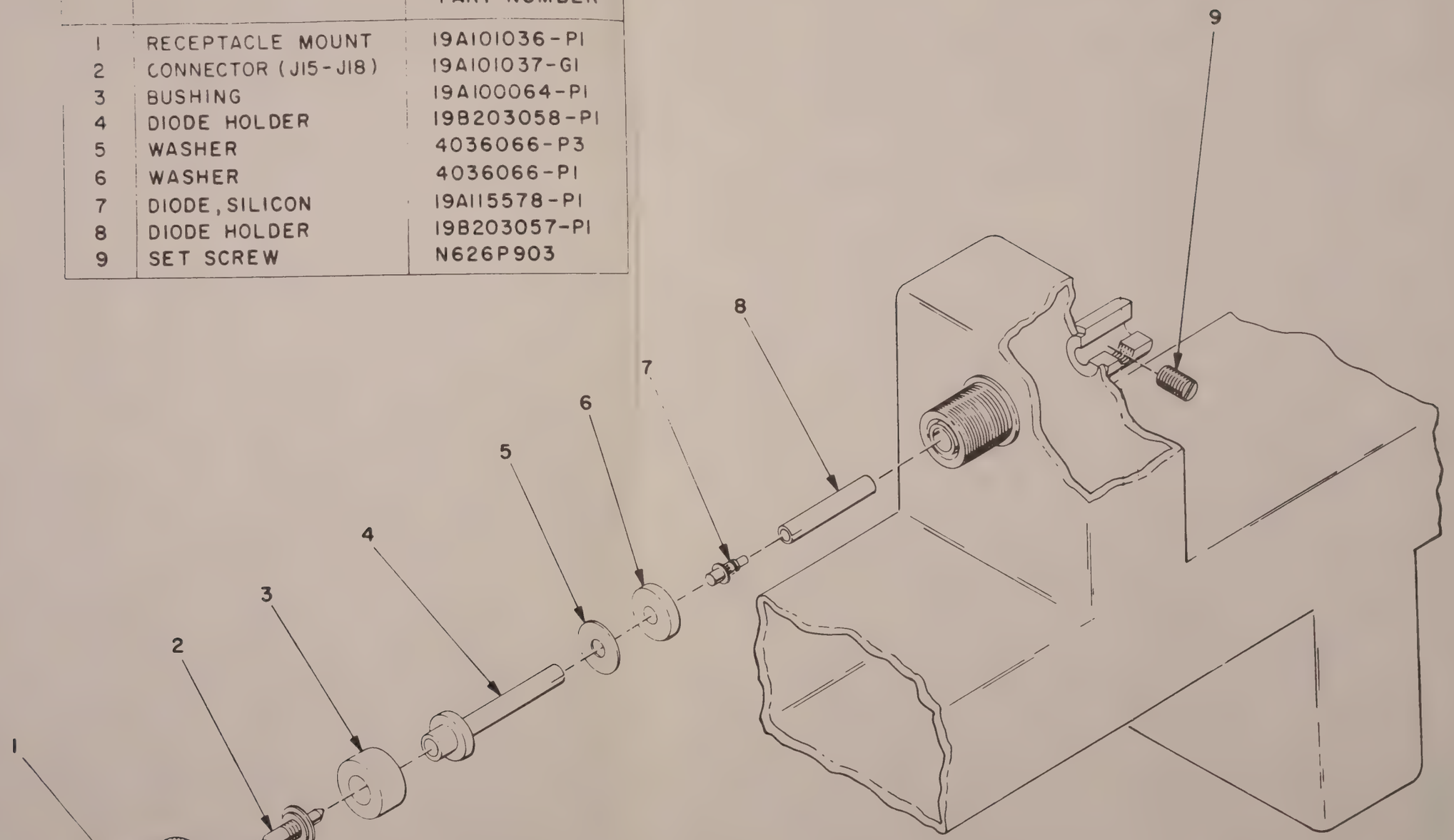
PART-PART NUMBER CROSS REFERENCE TABLE

Pictoral Diagram

RECEIVER MIXER DIODE ASSEMBLY
FIGURE 1

(Drawing No. 19D414134, Rev. 0)

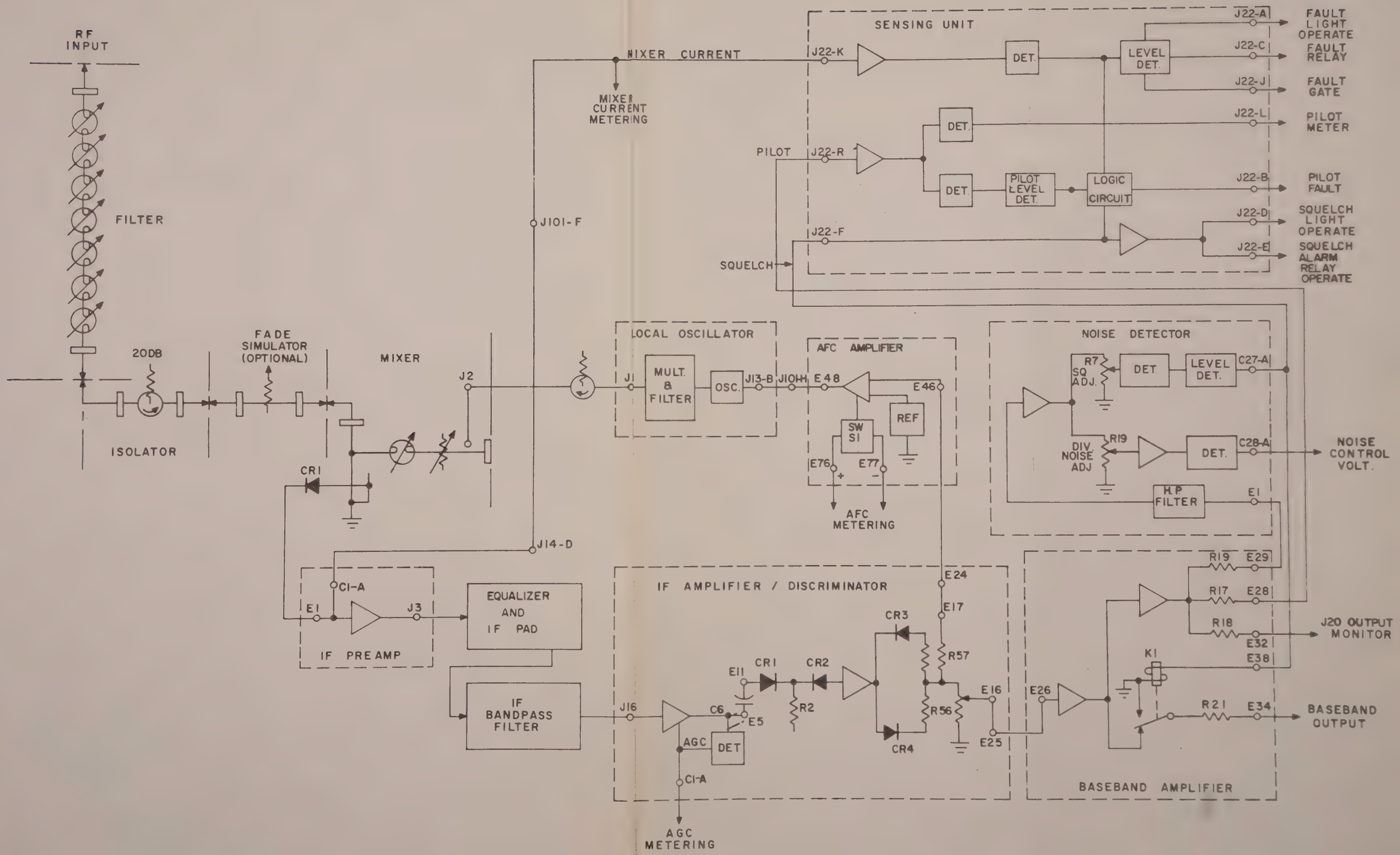
ITEM	PART	GE PART NUMBER
1	RECEPTACLE MOUNT	19A101036-P1
2	CONNECTOR (J15-J18)	19A101037-G1
3	BUSHING	19A100064-P1
4	DIODE HOLDER	19B203058-P1
5	WASHER	4036066-P3
6	WASHER	4036066-P1
7	DIODE, SILICON	19A115578-P1
8	DIODE HOLDER	19B203057-P1
9	SET SCREW	N626P903



Pictoral Diagram

WAVEGUIDE DIODE ASSEMBLY
FIGURE 2

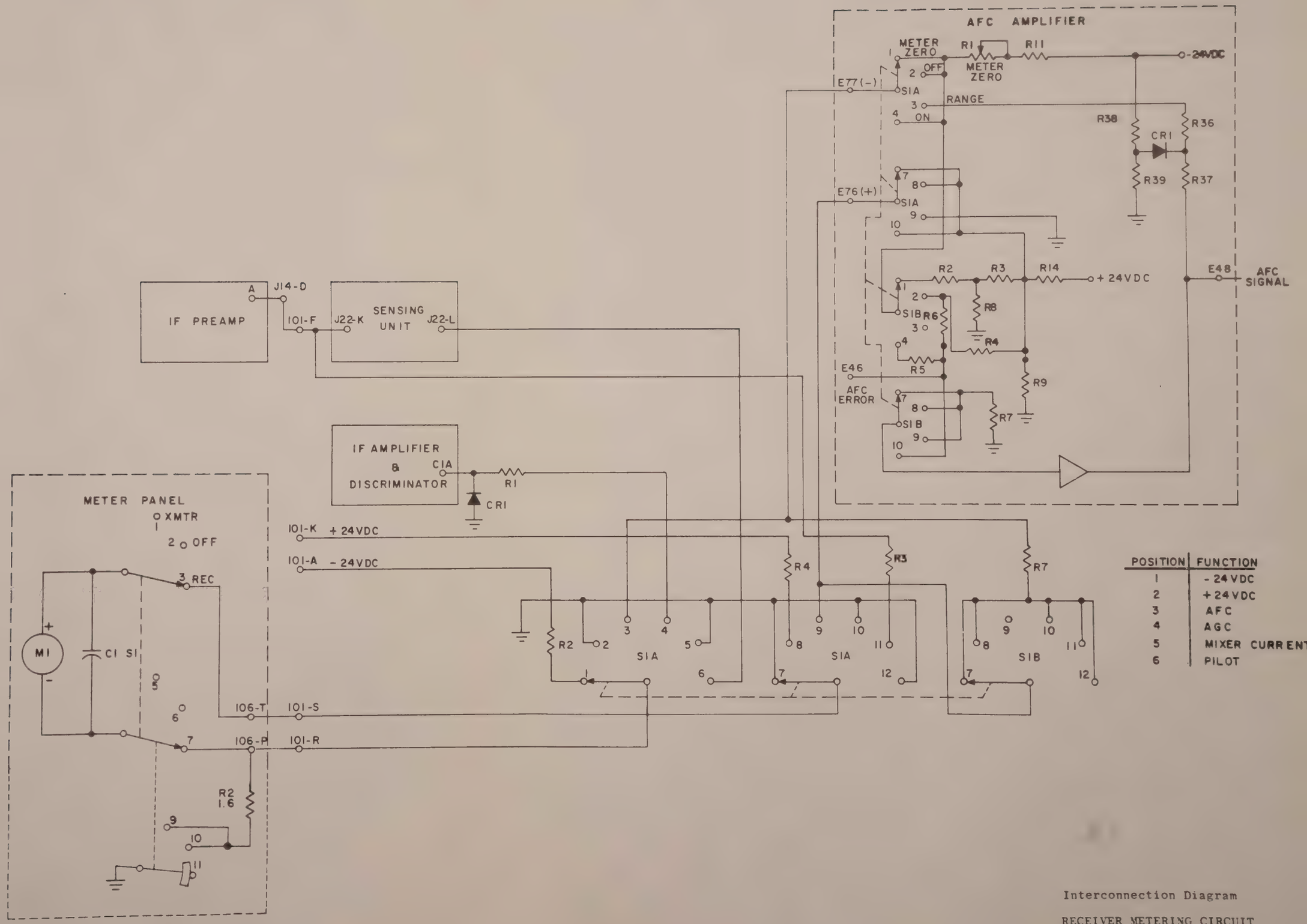
(Drawing No. 19D414136, Rev. 0)



Interconnection Diagram

TRS-696 RECEIVER

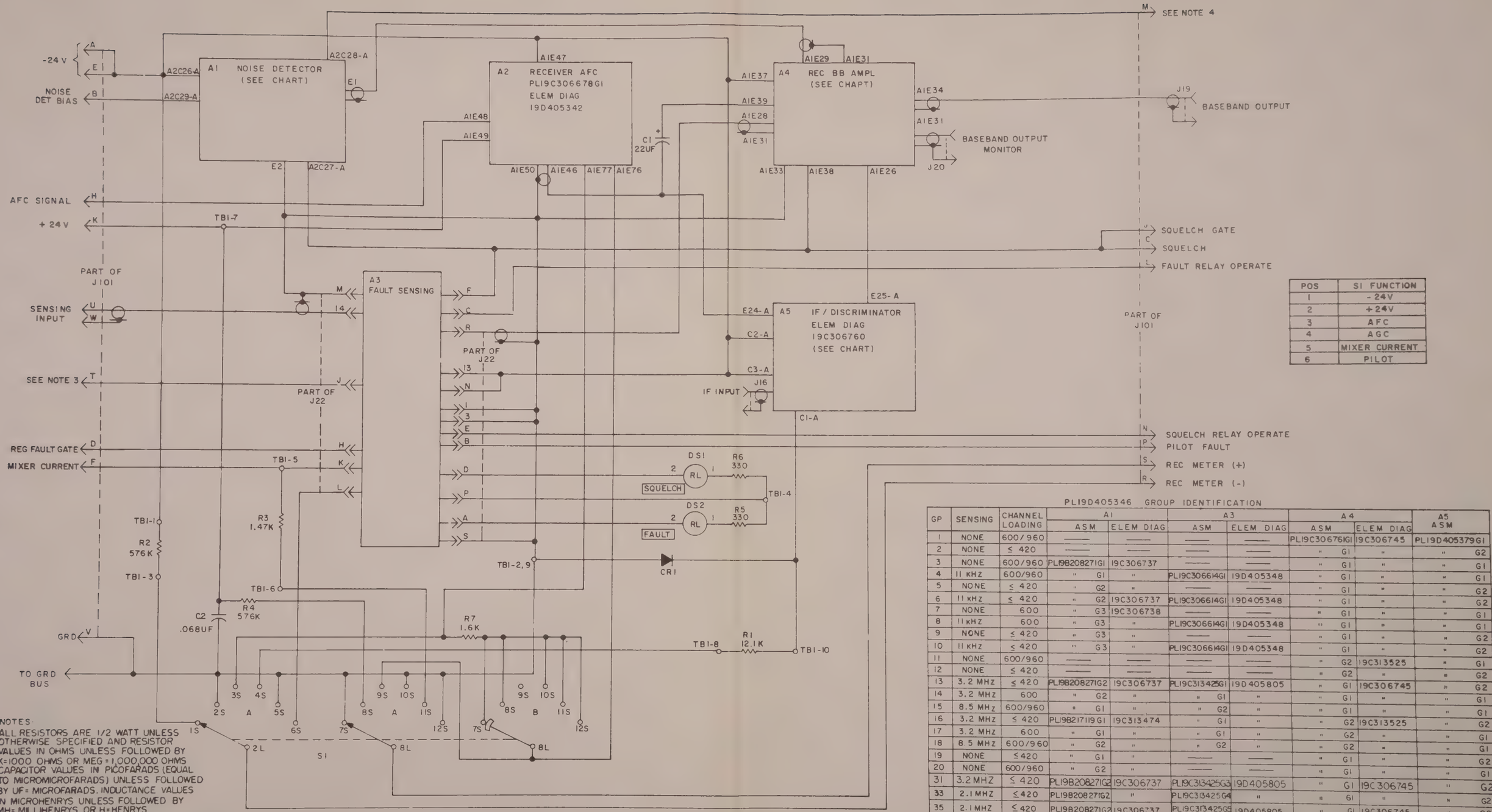
(Drawing No. 19D410705, Sh. 1, Rev. 2)



Interconnection Diagram

RECEIVER METERING CIRCUIT

(Drawing No. 19D410706, Rev. 1)



POS	SI FUNCTION
1	-24V
2	+24V
3	AFC
4	AGC
5	MIXER CURRENT
6	PILOT

NOTES:

1-ALL RESISTORS ARE 1/2 WATT UNLESS OTHERWISE SPECIFIED AND RESISTOR VALUES IN OHMS UNLESS FOLLOWED BY K=1000 OHMS OR MEG=1,000,000 OHMS CAPACITOR VALUES IN PICOFARADS (EQUAL TO MICROMICROFARADS) UNLESS FOLLOWED BY UF= MICROFARADS. INDUCTANCE VALUES IN MICROHENRYS UNLESS FOLLOWED BY MH= MILLIHENRYS OR H=HENRYS

2- PINS 1 & A, 2 & B THRU 15 & S OF J22 ARE SHORTED WHEN THE SENSING UNIT IS REMOVED.

3-FUNCTION OF PIN 'T' IN GROUPS 1 THRU 10 IS "FAULT GATE" FOR GROUPS 11 THRU 20" + 24V"

4-FUNCTION OF PIN 'M' IN GROUPS 1 THRU 15 IS "NOISE" CONTROL VOLT." FOR GROUPS 16 THRU 20 "NOISE FAULT"

PLI9D405346 GROUP IDENTIFICATION

GP	SENSING	CHANNEL LOADING	A1 ASM	A1 ELEM DIAG	A3 ASM	A3 ELEM DIAG	A4 ASM	A4 ELEM DIAG	A5 ASM
1	NONE	600/960	——	——	——	——	PLI9C30676GI	I9C306745	PLI9D405379GI
2	NONE	≤ 420	——	——	——	——	" G1	"	" G2
3	NONE	600/960	PLI9B208271GI	I9C306737	——	——	" G1	"	" G1
4	11 KHZ	600/960	" G1	"	PLI9C306614GI	I9D405348	" G1	"	" G1
5	NONE	≤ 420	" G2	"	——	——	" G1	"	" G2
6	11 KHZ	≤ 420	" G2	I9C306737	PLI9C306614GI	I9D405348	" G1	"	" G2
7	NONE	600	" G3	I9C306738	——	——	" G1	"	" G1
8	11 KHZ	600	" G3	"	PLI9C306614GI	I9D405348	" G1	"	" G1
9	NONE	≤ 420	" G3	"	——	——	" G1	"	" G2
10	11 KHZ	≤ 420	" G3	"	PLI9C306614GI	I9D405348	" G1	"	" G2
11	NONE	600/960	——	——	——	——	" G2	I9C313525	" G1
12	NONE	≤ 420	——	——	——	——	" G2	"	" G2
13	3.2 MHZ	≤ 420	PLI9B208271G2	I9C306737	PLI9C313425GI	I9D405805	" G1	I9C306745	" G2
14	3.2 MHZ	600	" G2	"	" G1	"	" G1	"	" G1
15	8.5 MHZ	600/960	" G1	"	" G2	"	" G1	"	" G1
16	3.2 MHZ	≤ 420	PLI9B217119G1	I9C313474	" G1	"	" G2	I9C313525	" G2
17	3.2 MHZ	600	" G1	"	" G1	"	" G2	"	" G1
18	8.5 MHZ	600/960	" G2	"	" G2	"	" G2	"	" G1
19	NONE	≤420	" G1	"	——	——	" G1	"	" G2
20	NONE	600/960	" G2	"	——	——	" G1	"	" G1
31	3.2 MHZ	≤ 420	PLI9B208271G2	I9C306737	PLI9C313425G3	I9D405805	" G1	I9C306745	" G2
33	2.1 MHZ	≤420	PLI9B208271G2	"	PLI9C313425G4	"	" G1	"	" G2
35	2.1 MHZ	≤420	PLI9B208271G2	I9C306737	PLI9C313425G5	I9D405805	" G1	I9C306745	" G2

SEMI-CONDUCTOR CHART

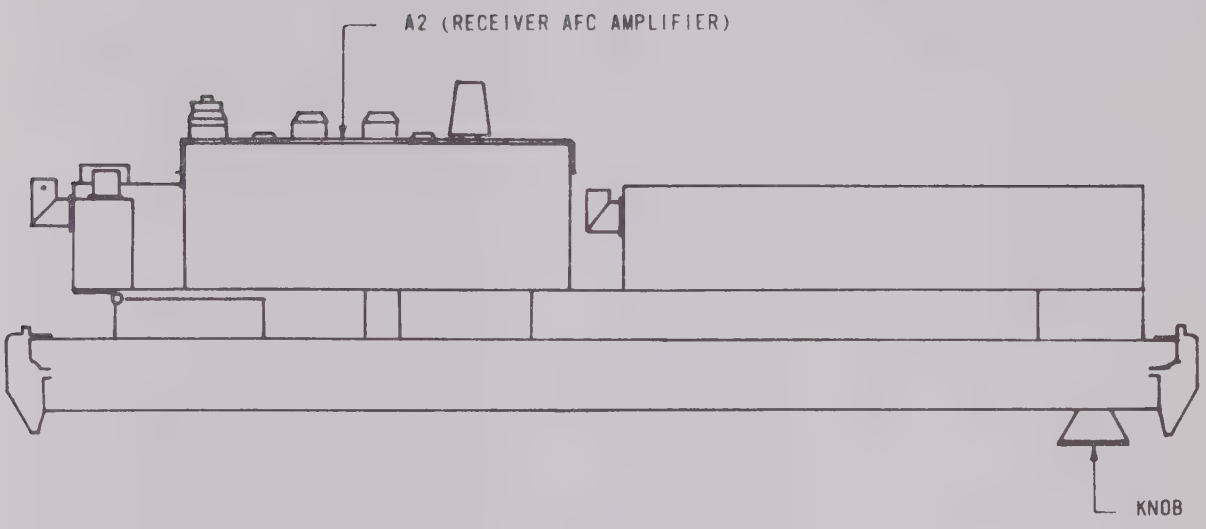
ITEM NO.	G.E IDENT NO.	SIMILAR TO * JEDEC REG NO.
CR1	19A115250P1	SSD-753

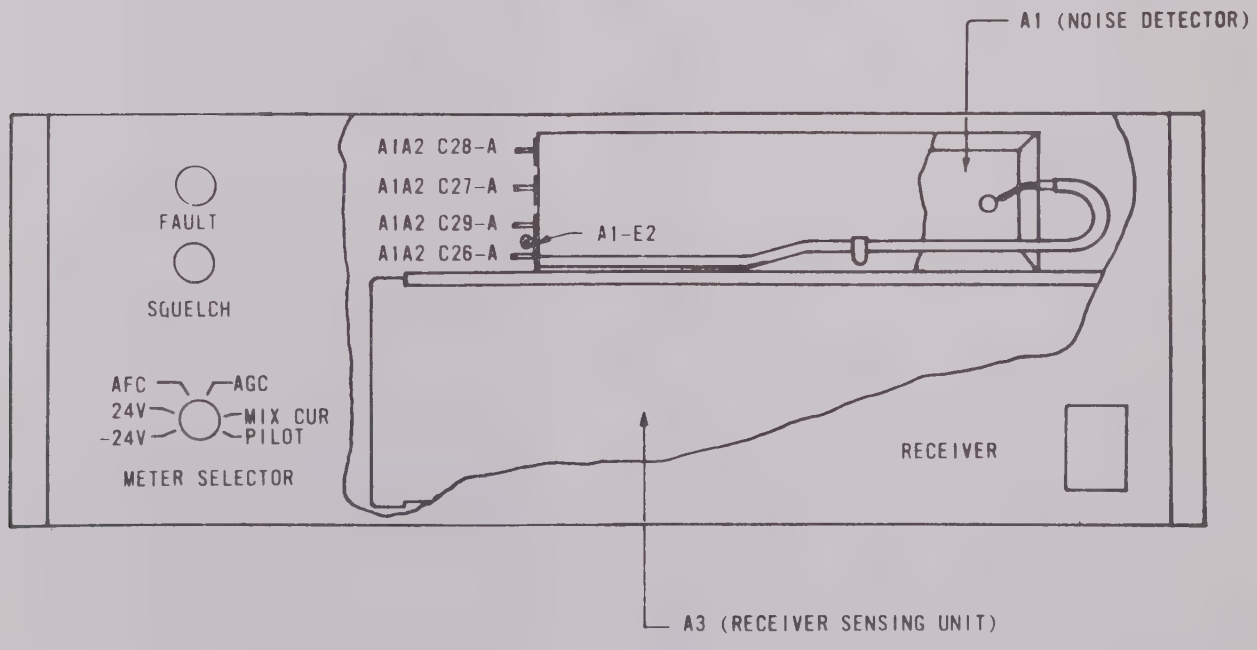
* FOR REFERENCE ONLY NOT RECOMMENDED FOR EXACT REPLACEMENT

Elementary Diagram

RECEIVER DOOR
PL-19D405346-G1 thru G20, G31, G33 & G35

(Drawing No. 19D409026, Sh. 1, Rev. 3)





Service Outline

RECEIVER DOOR
PL-19D405346-G3 thru G10,
G13 thru G20, G31, G33 & G35

(Drawing No. 19C313977, Rev. 0)

PARTS LIST

RECEIVER DOOR
19D405346-G1 THRU G35

SYMBOL	GE PART NO.	DESCRIPTION
A1	19B208271-G1	Noise Detector. (Used in G3, 4, and 15).
	19B208271-G2	Noise Detector. (Used in G5, 6, 13, 14, 31, 33, and 35).
	19B208271-G3	Noise Detector. (Used in G7-10).
	19B217119-G1	Noise Detector. (Used in G16, 17, and 19).
	19B317119-G2	Noise Detector. (Used in G18, and 20).
	19B217418-G1	Noise Comparator. (Used in G25, 27, 28, 32, and 34).
	19B217418-G2	Noise Comparator. (Used in G26, 29, and 30).
A2	19C306678-G1	Receiver AFC Amplifier. (Used in G1, 2, 11, 12, 20-24).
A3	19C306614-G1	Receiver Sensing. (Used in G4, 6, 8, and 10).
	19C313425-G1	Receiver Sensing. (Used in G13, 14, 16, 17, 25, and 28).
	19C313425-G2	Receiver Sensing. (Used in G15, 18, 26, and 30).
	19C313425-G3	Receiver Sensing. (Used in G31).
	19C313425-G4	Receier Sensing. (Used in G32-34).
	19C313425-G5	Receiver Sensing. (Used in G35).
A4	19C306761-G1	Baseband Amplifier. (Used in G1, 2, 23, and 24).
	19C306761-G2	Baseband Amplifier. (Used in G11, 12, 21, and 22).
A5	19D405379-G1	IF Discriminator. (Used in G1, 11, 21, and 23).
	19C405379-G2	IF Discriminator. (Used in G2, 12, 22, and 24).
		- - - - - - - - - CAPACITORS - - - - - - - - -
C1	5496267-P19	Tantalum: 22 µf ±20%, 35 VDCW; sim to Sprague Type 150D.
C2	19B209243-P6	Polyester: 0.068 µf ±20%, 50 VDCW.
		- - - - - - - DIODES AND RECTIFIERS - - - - - -
CR1	19A115250-P1	Silicon.
		- - - - - - - - - INDICATORS - - - - - - - - - -
DS1 and DS2	19A115825-P1	Lamp, incandescent: 28 v; sim to Drake 2840.
		- - - - - - - JACKS AND RECEPTACLES - - - - - -
J19	7776570-P17	Receptacle, bulkhead: coaxial, 500 v peak. Military Type UG-1094/U.
J22	19B209014-P1	Connector, printed board: 15 contacts; sim to Precision Connectors 60-062SW-15.
J101	19B209227-P7	Plug: 38 contacts; sim to Elco 00-8016-038-000-013.
		- - - - - - - - - RESISTORS - - - - - - - - -
R1	5495948-P309	Deposited carbon: 12,100 ohms ±1%, 1/2 w; sim to Texas Instrument CD1/2MR.
R2	5495948-P474	Deposited carbon: 576,000 ohms ±1%, 1/2 w; sim to Texas Instrument CD1/2MR.
R3	5495948-P217	Deposited carbon: 1470 ohms ±1%, 1/2 w; sim to Texas Instrument CD1/2MR.
R4	5495948-P474	Deposited carbon: 576,000 ohms ±1%, 1/2 w; sim to Texas Instrument CD1/2MR.
R5 and R6	3R77-P331J	Composition: 330 ohms ±5%, 1/2 w.
R7	3R77-P162J	Composition: 1600 ohms ±5%, 1/2 w.
		- - - - - - - - - SWITCHES - - - - - - - - -
S1	19B209402-P3	Rotary: 2 sections, 4 poles, 6 positions; sim to Oak Type JC.
		- - - - - - - - TERMINAL BOARDS - - - - - - - - -
TB1	7775500-P26	Phen: 10 terminals.
		- - - - - - - - - SOCKETS - - - - - - - - - -
XDS1 and XDS2	19B201122-P2	Lampholder: sim to Drake Mfg 121 Series.
		- - - - - - - MISCELLANEOUS - - - - - - - - -
	19B201122-P4	Cap, lens: red translucent nylon. (Used with DS1 and DS2).
	4039182-G2	Knob: sim to Eastman Chemical 41659 (modified). (Used with S1).

*COMPONENTS ADDED, DELETED OR CHANGED BY PRODUCTION CHANGES

PRINCIPLES OF OPERATION

RECEIVER MIXER
PL-19D405283-G1 thru -G6

GENERAL

Incoming signal and signal from the local oscillator are combined to produce a 70 MHz IF signal, and the IF signal is passed through a preamplifier in the receiver mixer assembly. The assembly consists of a section of waveguide that contains the mixer diode and the circuitry needed to match into the incoming and local oscillator signal sources, and to which the IF preamplifier is mounted.

The preamplifier is a five-stage amplifier with low noise figure. Its principal function is to raise the 70 MHz IF signal to an adequate level so the loss incurred in the IF equalizer, IF pad and IF filter that follow will not alter noise figure. It also supplies a dc voltage proportional to mixer current to the receiver metering and sensing circuits. The amplifier is constructed on a printed wire board and is mounted inside a box attached to the mixer assembly.

SPECIFICATIONS

Mixer

Frequency Range:

Common Carrier Band:	5925 to 6425 MHz
PSIT Band:	6575 to 6875 MHz
Government Band:	7125 to 8400 MHz

IF Preamplifier

Output Impedance:	50 ohms
Available Gain:	30 dB
Noise Figure:	2.2 dB maximum
Bandpass:	±10 MHz within 0.25 dB
Supply Voltage:	-24 Vdc

DESCRIPTION

RECEIVER MIXER

The receiver mixer is a section of rectangular waveguide, open at one end and closed at the other, which has an attenuator, three matching screws and a filter for the local oscillator signal, a mixer diode and three matching screws for the incoming signal and a test port built into it. The open end is connected to the receiver waveguide assembly.

Incoming signal enters the mixer from the receiver waveguide assembly. Three matching screws and a test port are located near the point of entry. The mixer is matched into the receiver waveguide assembly by adjustment of the three matching screws. Local oscillator signal can be monitored or a signal from an external source can be injected at the test port.

Local oscillator signal is applied to jack J2 which is located at the closed end of the assembly. The mixer is matched to the local oscillator and the amount of local oscillator energy coupled into it is set by adjustment of the three matching screws and the attenuator located near the closed end. The signal is then passed through a filter tuned to the local oscillator frequency.

The mixer diode is located between the local oscillator filter and the received signal matching screws. Local oscillator signal not absorbed by the mixer diode is terminated by the ferrite isolator in the receiver waveguide assembly. Incoming signal cannot travel any farther than the local oscillator filer which, being tuned to the local oscillator frequency, appears as a short to it. Heterodyning occurs due to the nonlinearity introduced by mixer diode CR1, and both the sum and difference frequencies appear. The sum frequency (a signal in the 12 GHz range) is coupled into absorbers mounted on each side of the waveguide through a number of holes in the waveguide wall. The difference frequency (the 70 MHz IF signal) developed in the mixer diode is fed directly into the IF preamplifier.

IF PREAMPLIFIER

The input to the IF preamplifier is the 70 MHz signal developed in the mixer diode. This signal is amplified by a five-stage amplifier with an available gain of 30 dB. All five stages are connected in the common base configuration which has a very constant gain, low input impedance and high output impedance. The preamplifier also provides a dc voltage proportional to mixer diode bias current to the receiver metering and sensing circuits. Refer to Elementary Diagram 19D405298.

The 70 MHz input signal is coupled into Q1 by the two-section filter formed by mixer output capacity, C2, L2, C3 and the input inductance of Q1. Variable capacitor C2 is adjusted to resonate L2 at 70 MHz. The ground return for the mixer diode is through L2 and R1, so the voltage developed across R1 is proportional to mixer current. This voltage is made available to the metering and sensing circuits through terminal C1-A. A red line reading on the meter occurs when mixer diode current is about three milliamperes.

The input impedance of stage Q2 is about 4 ohms. This is transformed to about 16 ohms by broadband transformer T1. Resistor R5 is series with the 16 ohms forms the load for the "T" equivalent double-tuned transformer consisting of the output capacity of Q1, L3, C7 and L4. This circuit, which couples the signal from stage Q1 into stage Q2, determines the bandwidth and response of the preampli-

fier. All the remaining stages are designed to have a very broadband response.

The output current of stage Q2 is stepped up by a factor of four with cascaded broadband transformers T2 and T3 and applied to stage Q3. The high output impedance of Q2 is matched to the low input impedance of Q3 due to the impedance transformation of 16 in cascaded transformers T2 and T3. A very broadband response (about 100 MHz) is the result of the very small output capacity of Q2 and low input inductance of Q3. The collector of Q2 is not resistively loaded in order to obtain the best noise figure.

The interstage networks between Q3 and Q4 and between Q4 and Q5 are basically the same as that between Q2 and Q3 described above. The only difference is that the collectors of stages Q3 and Q4 are resistively loaded by R13 and R18 respectively. These resistors are used to flatten the frequency response of these stages. Resistor R12 in the base circuit of Q3 is used to adjust preamplifier gain to the value desired. When the value of this resistor is changed a corresponding change in the division of signal current between R13 and T4 occurs. For example, if R12 is increased in value, the input impedance of T4 is increased whihc results in more current through R13 and less through T4 and the overall gain of the amplifier is reduced. Conversely, lowering the value of R12 results in an increase in overall gain.

The output resistance of the amplifier is determined by R22 in the collector circuit of stage Q5. This has been set at 50 ohms.

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MAINTENANCE

RECEIVER MIXER/PREAMPLIFIER
PL-19D405283-G1-G5/PL-19D409980-G1 thru -G3

2.0 GENERAL

2.0.1 Bench maintenance procedures for the receiver mixer consist of: (1) input tuning, frequency response, and amplifier gain measurements, (2) noise measurements, and (3) return loss measurement. The frequency response of the preamplifier should be flat within 0.15 db from 60 to 80 MHz. L3, L4, and C7 are tuned to obtain the desired frequency response. L3 controls the center frequency response, L4 controls the coupling, and C7 controls the tilt. The value of R5 affects frequency response and gain and its value may be changed as necessary within the limits specified.

2.0.2 The preamplifier gain is 30 db and may be adjusted by changing the value of R14 within the range of 10 to 51 ohms. Changing the value of either R5 or R14, or repositioning any components will affect frequency response and gain and will necessitate repeating the maintenance procedures. Amplifier gain is achieved through the use of small torroidal interstage transformers. The magnetic properties of these interstage transformers will change permanently when subjected to external magnetic fields, thereby destroying amplifier frequency response and gain. Extreme caution should be exercised to avoid the use of any magnetized tools when working with or making adjustments to the preamplifier.

2.0.3 The preamplifier utilizes a five stage amplifier connected in the common base configuration to obtain the best noise figure. The noise figure is measured at 70 MHz and should not exceed 8.7 db. C2 controls the center frequency and is also adjusted to obtain the best noise figure. In addition, transistor Q1 affects the noise figure and in some instances it may be necessary to replace it.

2.0.4 The signal return loss is checked by sweeping the preamplifier output from 60 to 80 MHz while monitoring J3 with a reflectometer. The return loss shall not exceed the limits specified in the maintenance procedure. Although there are no adjustments as such to correct for excessive return loss, it is affected by such things as component location and lead dress. Note that R22 has a specially formed lead which serves as an inductor. Should it ever become necessary to replace it, caution should be exercised when forming the new lead to assure that the correct amount of inductance is provided.

2.0.5 Refer to drawing 19D405298 (PL-19D405283-G1 thru -G5) and to drawing 19D409310 (PL-19D409980-G1 thru -G3) for the elementary diagram and to drawing 19D410709 (PL-19D405283-G1 thru -G5) and to drawing 19D409299 (PL-19D409980-G1 thru -G3) for the service outline. The service outline may be used for the maintenance procedures in the sequence given.

2.1 TEST EQUIPMENT REQUIRED (or equivalent)

2.1.1 The test equipment required for maintenance of the receiver mixer is listed in figure 1. Test set up diagrams are illustrated in figures 5, 6, and 8. Figure 2 is an elementary diagram of the detector, figure 3 is an elementary diagram of the 70 MHz filter and also the associated tuning specifications, and figure 4 is a drawing of the receiver mixer test cover of which a copy may be used as a template to mark the test cover for drilling. Components for the detector, 70 MHz filter and a test cover for the receiver mixer may be purchased from the General Electric Company, Communication Products Department, Lynchburg, Virginia.

TEST EQUIPMENT	MODEL	REQUIREMENT
Amplifier (2) (Hewlett-Packard)	461A	20-40 db at 70 MHz, 50 ohms
Attenuator Boonton	80-ZH3	6 db
Attenuator (Telonic)	TC-50A	0-1 db variable
Cover, Test		Figure 4
Detector		Fabricate according to figure 2
Dummy Mixer* (General Electric)	19B208211G2 19B208211G2 (for PL-19D405283-G1 thru -G5 only)	
Filter		Fabricate according to figure 3
Filter IF	GE-19C304331G1	
Noise Figure Meter (Hewlett-Packard)	342A	70 MHz response; 50 ohm impedance
Noise Source (Hewlett-Packard)	343A	60-80 MHz noise; 50 ohm impedance
Oscilloscope (Tektronix)	531	
Plug-in Unit	Type H	High gain (5 mv per centimeter

*G1 Dummy Mixer is used in the common carrier and PSIT band.
G2 Dummy Mixer is used in the Government band.

Figure 1. Test Equipment Required (or equivalent) (1 of 2)

TEST EQUIPMENT	MODEL	REQUIREMENT
Power Supply (Hewlett-Packard)	721A	-24 vdc
Reflectometer (Rhode Schwarz)	3569/50	
RF Voltmeter (Hewlett-Packard)	411A	
Sweep Generator (Kay Electric)	159B	60-80 MHz sweep
Tee Probe (Hewlett-Packard)	11024A	
Termination (Hewlett-Packard)	908A	50 ohm
Plug-in Unit (Kay Electric)	7660B	Markers at 60, 70, and 80 MHz

Figure 1. Test Equipment Required (or equivalent) (2 of 2)

2.2 MAINTENANCE PROCEDURES

2.2.1 INPUT TUNING, FREQUENCY RESPONSE AND GAIN MEASUREMENT

(1) Fabricate detector and filter as illustrated in figures 2 and 3.

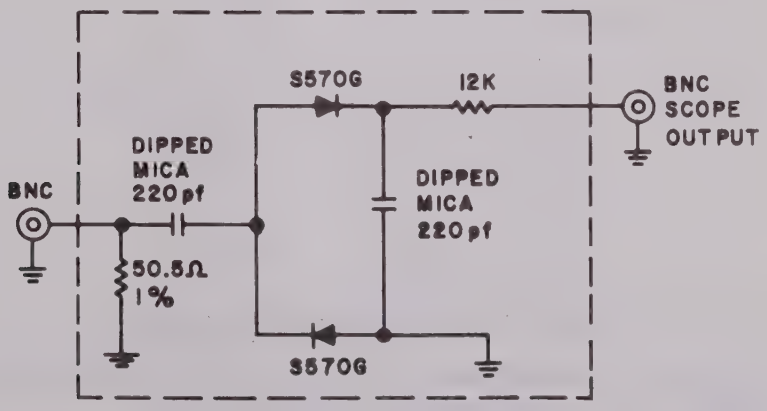
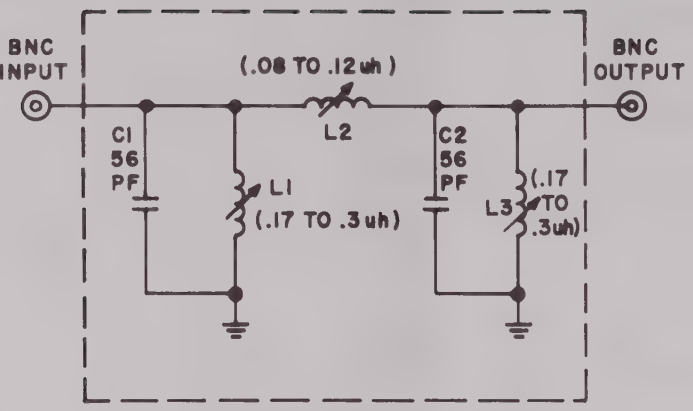
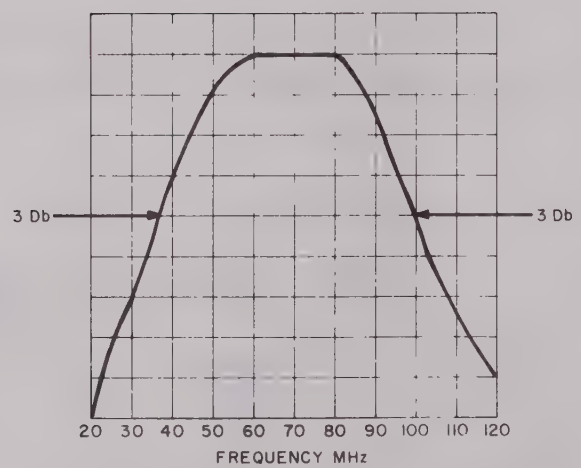


Figure 2. Detector Elementary Diagram



70 MHz FILTER

C1, C2 CAPACITOR	GE-B7489162P21
L1, L3 COIL, RF	GE-4036600G12
L2 COIL RF	GE-4036600G8



70 MHz FILTER TUNING SPECIFICATIONS

(1) RESPONSE: AS SHOWN ABOVE WITH 3db POINTS AT 38 AND 100 MHz
(2) RIPPLE: LESS THAN 0.1 db BETWEEN 60 AND 80 MHz
(3) INSERTION LOSS: LESS THAN 1.0 db

Figure 3. 70 MHz Filter Elementary & Tuning Diagram

(2) Remove cover from unit and remove Q1 from socket. Install test cover on receiver mixer. (Refer to figure 4).

(3) Apply -24 vdc power to C21A and connect return to pin E2.

(4) Connect test equipment as illustrated in figure 5. Remove all attenuation from sweep generator.

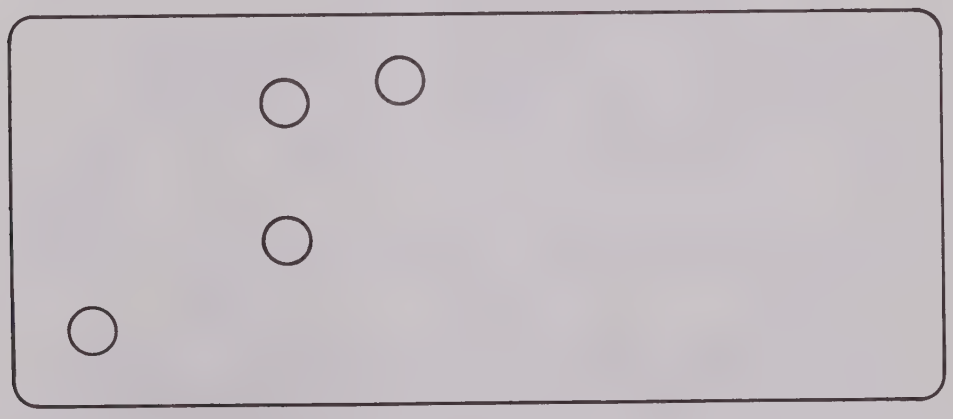
(5) Terminate sweep generator in 50 ohms and adjust output for a 60-80 MHz sweep at a level of 0.4 volts. Insert 19 db of attenuation.

(6) Inject marker at 70 MHz and adjust C2 to center response at 70 MHz.

(7) Remove cover and replace Q1; replace cover.

(8) Connect test equipment as illustrated in figure 6. On sweep generator, insert 33 db of attenuation.

(9) Calibrate oscilloscope for 0.2 db/cm by adjusting vertical gain for a change of 1 centimeter when Telonic attenuator is varied between 0 and 0.2 db.



RECEIVER MIXER TEST COVER
(NOTE 2)

NOTE:
1. ALL HOLES 5/16" DIAMETER
2. A COPY OF THIS DRAWING MAY BE USED AS A TEMPLATE TO MARK TEST COVER.

Figure 4. Receiver Mixer Test Cover Template

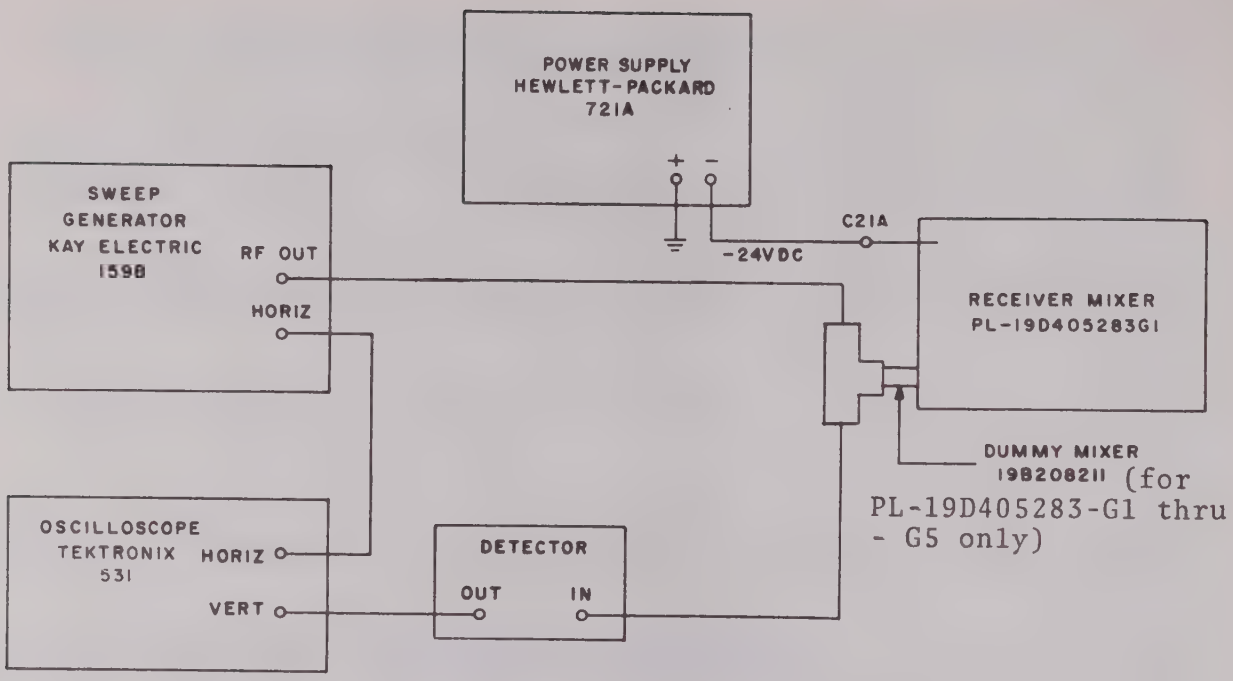
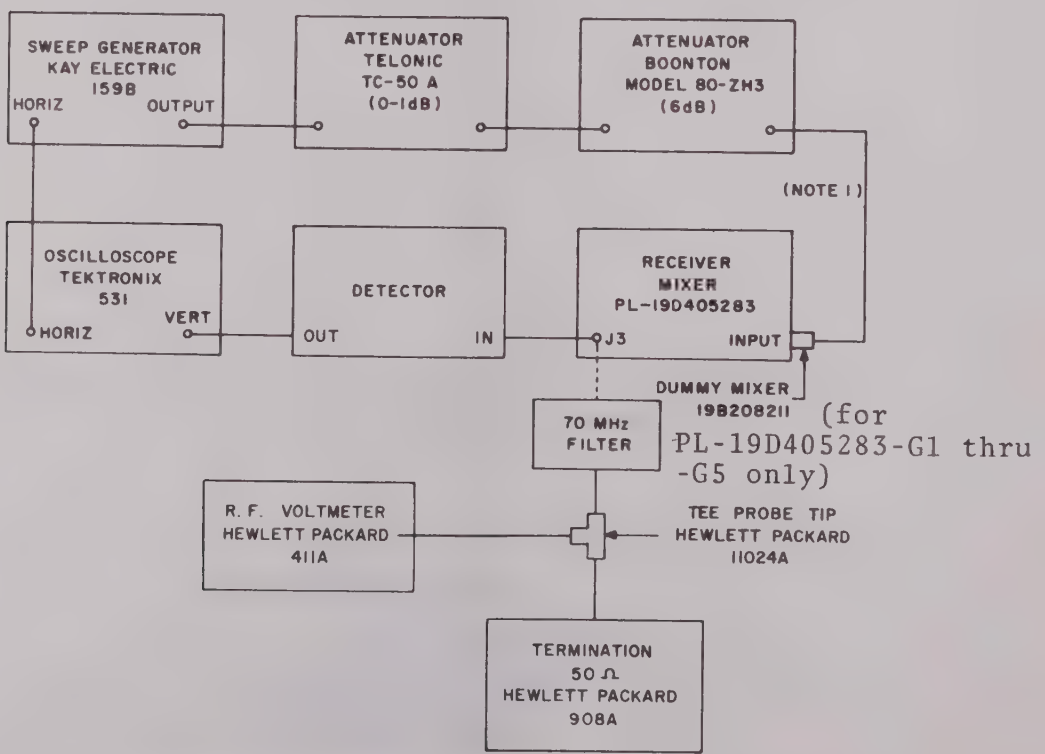


Figure 5. Input Tuning and Frequency Response Test Set Up Diagram



NOTE:
1. DO NOT USE COAXIAL CABLE FOR THIS CONNECTION. CONNECT ATTENUATOR DIRECTLY TO DUMMY MIXER.

Figure 6. Gain Measurement Test Set Up Diagram

CAUTION

Do not use magnetized tools. Close proximity of magnetized tools to interstage transformers will permanently affect frequency response and amplifier gain.

(10) Tune L3, L4, and C7 as necessary to obtain response curve shown in figure 7. L3 controls center frequency, L4 controls coupling, and C7 controls tilt.

NOTE

Repositioning components or changing the value of R5 affect frequency response and gain. If the required response cannot be obtained, the value of R5 may be changed to one of the following: 360, 390, 430, or 470 ohms. The largest value that provides the correct response should be used.

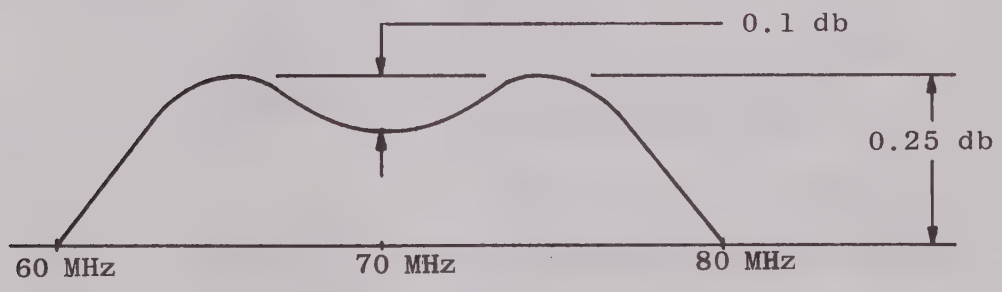


Figure 7. Frequency Response Curve

(11) Disconnect detector from receiver mixer output jack J3.

(12) Terminate rf voltmeter with 50 ohms and connect to J3 of the receiver mixer through the 70 MHz filter.

(13) Set sweep generator for CW operation at 70 MHz center frequency and adjust output level for -3 dbm.

(14) Disconnect rf voltmeter filter combination from J3 and connect it to the Telonic attenuator.

(15) Remove 20 db of attenuation from the sweep generator. The level indicated on the rf voltmeter should be -1.5 ± 0.5 dbm.

NOTE

If the above level is not within tolerance a new value for R14 must be chosen. This value must lie between 10 and 51 ohms. If the value of R14 is changed, repeat steps 5 through 13 until both the response and gain requirements are satisfied.

(16) Disconnect all test equipment except dummy mixer. Do not remove power.

2.2.2 PREAMPLIFIER NOISE CHECK

(1) Connect the HP-343A noise source to the dummy mixer.

(2) Connect the HP-342A noise figure meter through the HP-461A amplifier to J3. Set amplifier gain to 20 db.

(3) Adjust C2 for the best noise figure at 70 MHz. Noise figure shall not exceed 8.7 db.

NOTE

It may be necessary to replace Q1 to meet this requirement. If Q1 is replaced repeat steps 5 through 14 of paragraph 2.2.1.

(4) Disconnect test equipment.

2.2.3 RETURN LOSS MEASUREMENT

NOTE

Return loss of the preamplifier is primarily determined by the components in the final stage. Movement or relocation of any component will affect amplifier return loss, frequency response, and gain, and will necessitate repeating those procedures.

(1) Connect test equipment as illustrated in figure 8.

(2) Set sweep generator for a 60 to 80 MHz sweep, and insert 33 db attenuation.

(3) Set reflectometer to INCIDENT and adjust scope sensitivity for a deflection of 2 cm.

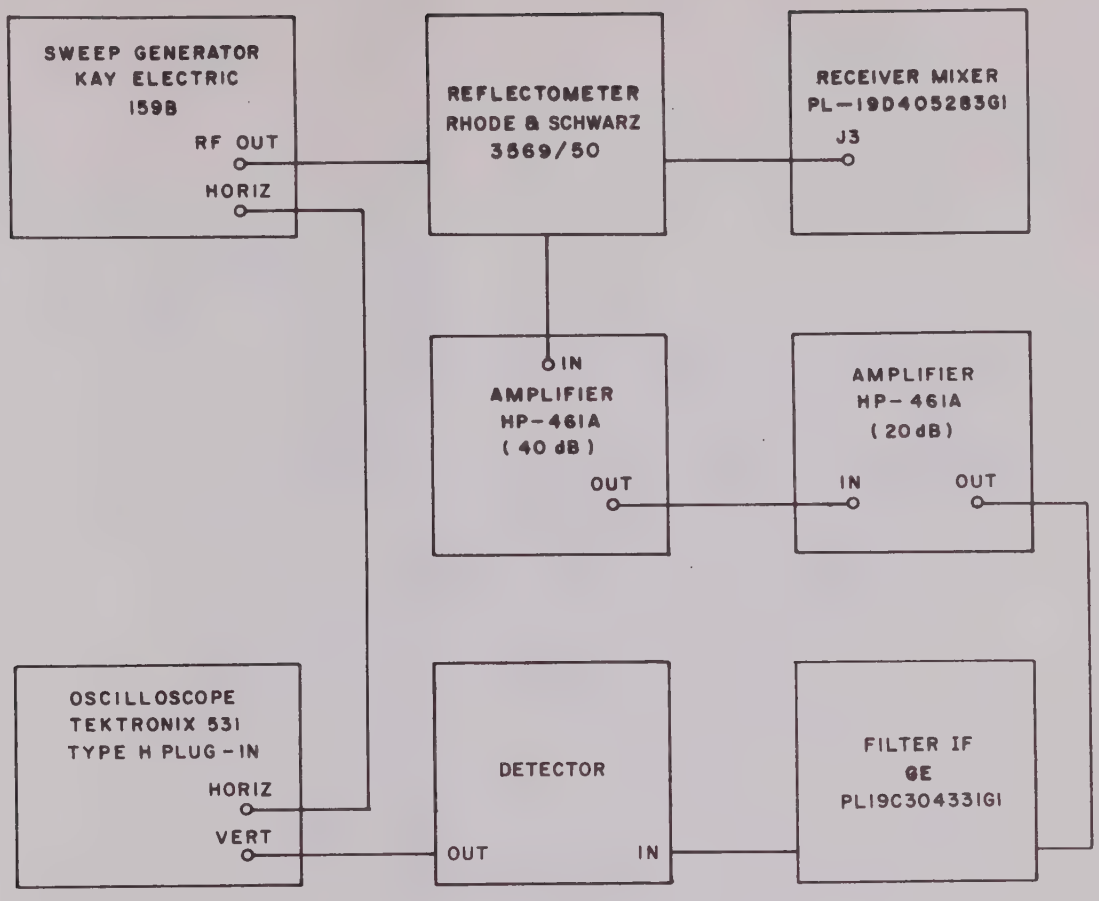


Figure 8. Return Loss Measurement Test Set Up Diagram

(4) On sweep generator, set attenuation to 3 db.

(5) Set reflectometer to REFLECTED. Vertical deflection on oscilloscope shall not exceed 2 cm between 70 and 80 MHz.

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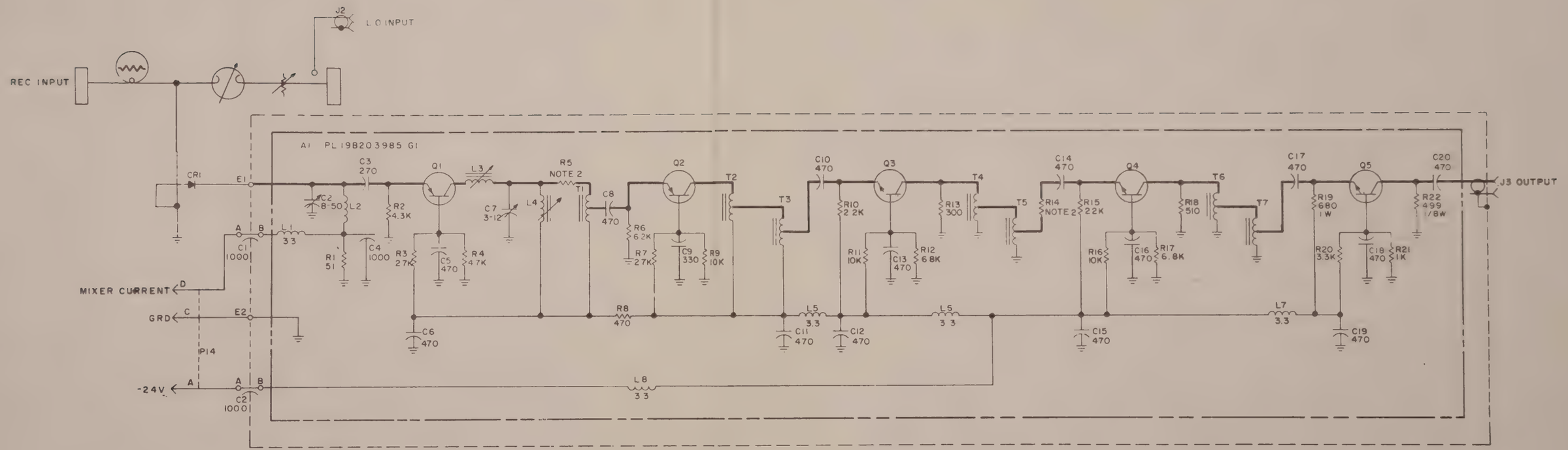


SEMI-CONDUCTOR CHART

ITEM NO	G E IDENT. NO	SIMILAR TO * JEDEC REG NO.
A1 Q1, A1 Q2	19A116490P1	
A1 Q3, A1 Q4	19A115440P1	
A1 Q5	19A115329P1	

* FOR REFERENCE ONLY NOT RECOMMENDED FOR EXACT REPLACEMENT

PL19D405283 GP IDENTIFICATION

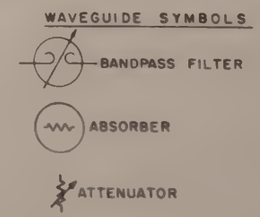
GP	FREQ RANGE
1&4	C.C. 5925 - 6425 MHz
2,5&6	PSIT 6575 - 6875 MHz
3	GOVT 7125 - 8400 MHz

NOTES:

1 - ALL RESISTORS ARE 1/2 WATT UNLESS OTHERWISE SPECIFIED AND RESISTOR VALUES IN OHMS UNLESS FOLLOWED BY K=1000 OHMS OR MEG=1,000,000 OHMS. CAPACITOR VALUES IN PICOFARADS (EQUAL TO MICROMICROFARADS) UNLESS FOLLOWED BY UF=MICROFARADS. INDUCTANCE VALUES IN MICROHENRYS UNLESS FOLLOWED BY MH=MILLIHENRYS OR H=HENRYS.

2 - A1 R5 & A1 R14 ARE SELECTED DURING TEST

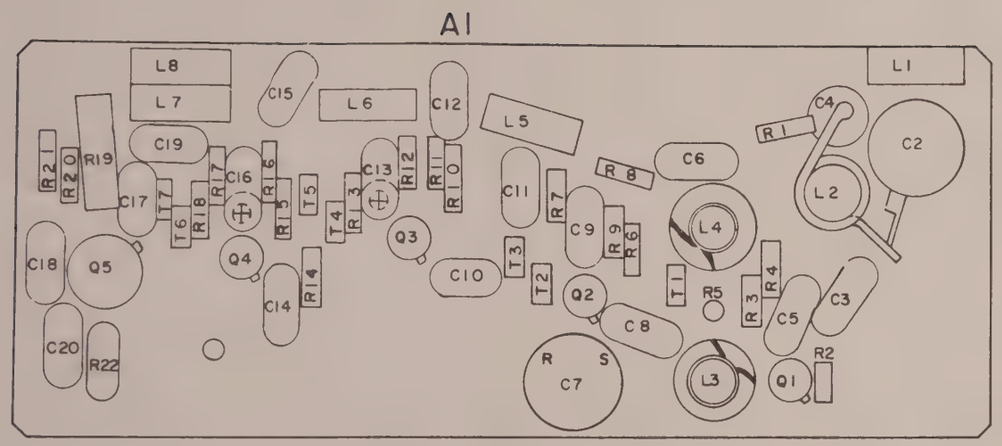
WAVEGUIDE SYMBOLS

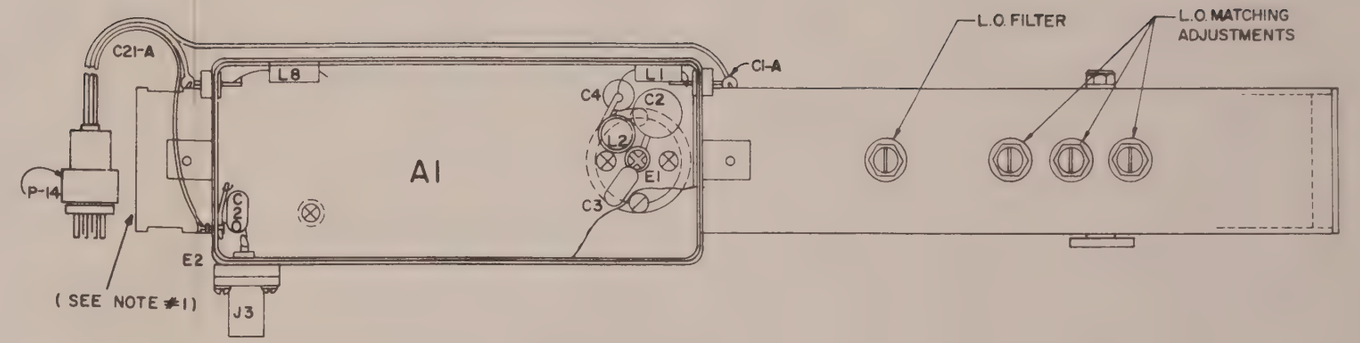


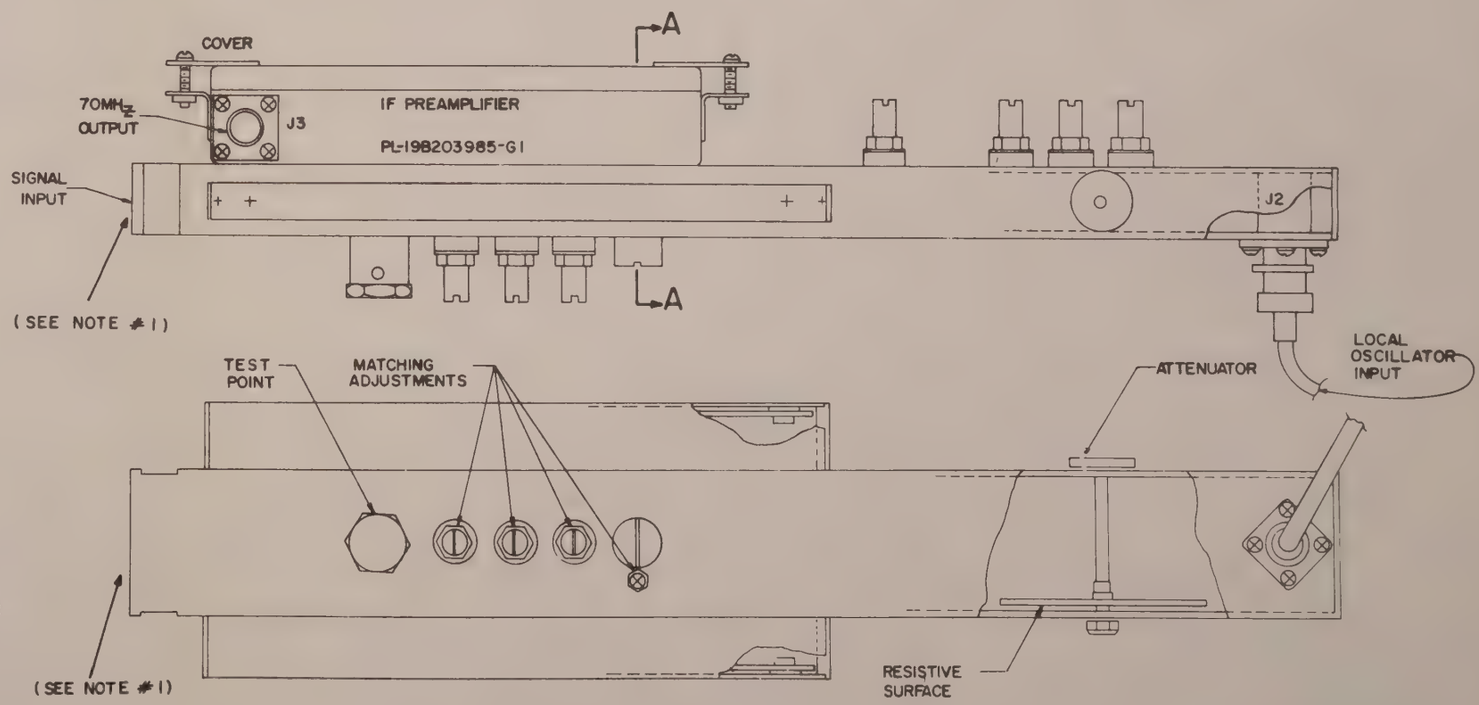
Elementary Diagram

RECEIVER MIXER/PREAMPLIFIER
PL-19D405283-G1 thru G6

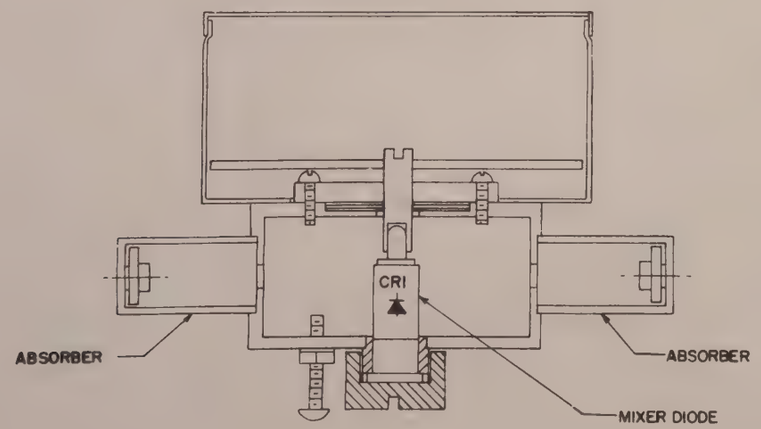
(Drawing No. 19D405298, Rev. 4)







SECTION A-A



GROUP NO.	BAND	FREQUENCY	TYPE CONNECTION
1	COM CARRIER	5.925-6.425 GHz	QUICK DISCONNECT
2	PSIT	6.575-6.875 GHz	QUICK DISCONNECT
3	GOVERNMENT	7.125-8.400 GHz	FLANGE
4	COM CARRIER	5.925-6.425 GHz	FLANGE
5	PSIT	6.575-6.875 GHz	FLANGE
6	PSIT	6.575-6.875 GHz	FLANGE

NOTE: 1. QUICK DISCOUNT IS SHOWN

Service Outline

RECEIVER MIXER
PL-19D405283-G1 thru G6, Rev. A

(Drawing No. 19D410709, Rev. 1)

PRODUCTION CHANGE SHEET

RECEIVER MIXER
PL-19D405283-G1 thru -G6

PL-19D405283 G1 thru -G6, REV. A

The following changes were made to preamplifier board A1: specifications for transistors Q1, Q2 and diode CR1 were changed, and the values of resistors R2, R4, R6, and R8 were changed.

PARTS LIST CHANGES

Symbol	GE Part No.	Description
Change:		
Q1 and Q2	19A116490-P1	Silicon, PNP.
R2	C3R152-P432J	Composition: 4300 ohms ±5%, 1/4 w.
R4	C3R152-P472J	Composition: 4700 ohms ±5%, 1/4 w.
R6	C3R152-P622J	Composition: 6200 ohms ±5%, 1/4 w.
R8	C3R152-P471J	Composition: 470 ohms ±5%, 1/4 w.
CR1	4036748-P7	Silicon.

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PARTS LIST

RECEIVER MIXER
19D405283-G1 thru -G6 REV. A

SYMBOL	GE PART NO.	DESCRIPTION
A1		PRE-AMPLIFIER BOARD 19B203985-G1
		- - - - - - - CAPACITORS - - - - - - - - - -
C2	5490446-P14	Variable, ceramic: approx 8-50 pf, 350 VDCW, temp coef -750 PPM; sim to Erie Style 557-31.
C3	7489162-P137	Silver mica: 270 pf ±10%, 500 VDCW; sim to Electro Motive Type DM-15.
C4	5493392-P107	Ceramic, stand-off: .001 µf +100% -0%, 500 VDCW; sim to Allen-Bradley Type SS5A.
C5 and C6	5490008-P143	Silver mica: 470 pf ±10%, 300 VDCW; sim to Electro Motive Type DM-15.
C7	5490446-P3	Variable, ceramic: approx 3-12 pf, 350 VDCW, temp coef 0 PPM; sim to Erie Style 557-36.
C8	5490008-P143	Silver mica: 470 pf ±10%, 300 VDCW; sim to Electro Motive Type DM-15.
C9	5490008-P139	Silver mica: 300 pf ±10%, 500 VDCW; sim to Electro Motive Type DM-15.
C10	7489162-P143	Silver mica: 470 pf ±10%, 300 VDCW; sim to Electro Motive Type DM-15.
C11 thru C19	5490008-P143	Silver mica: 470 pf ±10%, 300 VDCW; sim to Electro Motive Type DM-15.
C20	7489162-P143	Silver mica: 470 pf ±10%, 300 VDCW; sim to Electro Motive Type DM-15.
		- - - - - - -INDUCTORS - - - - - - - - - -
L1	7488079-P10	Choke, RF: 3.30 µh ±10%, 0.15 ohms DC res max; sim to Jeffers 4421-1.
L2	19A101840-P1	Coil.
L3	19B203468-G10	Coil.
L4	19B203468-G8	Coil.
L5 thru L8	7488079-P10	Choke, RF: 3.30 µh ±10%, 0.15 ohms DC res max; sim to Jeffers 4421-1.
		- - - - - - - TRANSISTORS - - - - - - - - - -
Q1 and Q2	19A115413-P1	Silicon, PNP (Prior to Rev. A)
*Q1 and Q2	19A116490-P1	Silicon, PNP (Changed at Rev. A)
Q3 and Q4	19A115440-P1	Silicon, NPN.
Q5	19A115329-P1	Silicon, NPN.
		- - - - - - - - - -RESISTORS- - - - - - - - - -
R1	3R152-P510J	Composition: 51 ohms ±5%, 1/4 w.
R2	3R152-P912J	Composition: 9100 ohms ±5%, 1/4 w. (Prior to Rev. A)
*R2	3R152-P432J	Composition: 4300 ohms ±5%, 1/4 w. (Changed at Rev. A)
R3	3R152-P272J	Composition: 2700 ohms ±5%, 1/4 w.
R4	3R152-P103J	Composition: 10,000 ohms ±5%, 1/4 w. (Prior to Rev. A)
*R4	3R152-P472J	Composition: 4700 ohms ±5%, 1/4 w. (Changed at Rev. A)
		NOTE The value of R5 must be obtained from the component, then find corresponding value in parts list for the correct part number.
R5	3R151-P361J	Composition: 360 ohms ±5%, 1/8 w.
R5	3R151-P391J	Composition: 390 ohms ±5%, 1/8 w.
R5	3R151-P431J	Composition: 430 ohms ±5%, 1/8 w.
R5	3R151-P471J	Composition: 470 ohms ±5%, 1/8 w.
R6	3R152-P302J	Composition: 3000 ohms ±5%, 1/4 w. (Prior to Rev. A)
*R6	3R152-P622J	Composition: 6200 ohms ±5%, 1/4 w. (Changed at Rev. A)
R7	3R152-P272J	Composition: 2700 ohms ±5%, 1/4 w.
R8	3R152-P202J	Composition: 2000 ohms ±5%, 1/4 w. (Prior to Rev. A)
*R8	3R152-P471J	Composition: 470 ohms ±5%, 1/4 w. (Changed to Rev. A)
R9	3R152-P103J	Composition: 10,000 ohms ±5%, 1/4 w.
R10	3R152-P222J	Composition: 2200 ohms ±5%, 1/4 w.
R11	3R152-P103J	Composition: 10,000 ohms ±5%, 1/4 w.
R12	3R152-P682J	Composition: 6800 ohms ±5%, 1/4 w.
R13	3R152-P301J	Composition: 300 ohms ±5%, 1/4 w.
		NOTE The value of R14 must be obtained from the component, then find corresponding value in parts list for the correct part number.
R14	3R151-P100J	Composition: 10 ohms ±5%, 1/8 w.
R14	3R151-P110J	Composition: 11 ohms ±5%, 1/8 w.
R14	3R151-P120J	Composition: 12 ohms ±5%, 1/8 w.
R14	3R151-P130J	Composition: 13 ohms ±5%, 1/8 w.
R14	3R151-P150J	Composition: 15 ohms ±5%, 1/8 w.
R14	3R151-P160J	Composition 16 ohms ±5%, 1/8 w.
R14	3R151-P180J	Composition: 18 ohms ±5%, 1/8 w.
R14	3R151-P200J	Composition: 20 ohms ±5%, 1/8 w.
R14	3R151-P220J	Composition: 22 ohms ±5%, 1/8 w.
R14	3R151-P240J	Composition: 24 ohms ±5%, 1/8 w.
R14	3R151-P270J	Composition: 27 ohms ±5%, 1/8 w.
R14	3R151-P300J	Composition: 30 ohms ±5%, 1/8 w.
R14	3R151-P330J	Composition: 33 ohms ±5%, 1/8 w.
R14	3R151-P360J	Composition: 36 ohms ±5%, 1/8 w.
R14	3R151-P390J	Composition: 39 ohms ±5%, 1/8 w.
R14	3R151-P430J	Composition: 43 ohms ±5%, 1/8 w.
R14	3R151-P470J	Composition: 47 ohms ±5%, 1/8 w.
R14	3R151-P510J	Composition: 51 ohms ±5%, 1/8 w.
R15	3R152-P222J	Composition: 2200 ohms ±5%, 1/4 w.
R16	3R152-P103J	Composition: 10,000 ohms ±5%, 1/4 w.
R17	3R152-P682J	Composition: 6800 ohms ±5%, 1/4 w.
R18	3R152-P511J	Composition: 510 ohms ±5%, 1/4 w.
R19	3R78-P681J	Composition: 680 ohms ±5%, 1/4 w.
R20	3R152-P332J	Composition: 3300 ohms ±5%, 1/4 w.
R21	3R152-P102J	Composition: 1000 ohms ±5%, 1/4 w.
R22	19B209294-P68	Metal film: 49.9 ohms ±1%, 1/8 w; sim to IRC Type CEA-TO.

*COMPONENTS ADDED, DELETED OR CHANGED BY PRODUCTION CHANGES

SYMBOL	GE PART NO.	DESCRIPTION
		- - - - - - TRANSFORMERS - - - - - - - - -
T1 thru T7	19A101377-G2	Coil.
		- - - - - - - -DIODES AND RECTIFIERS - - - - - - -
CR1	4036748-P6	Silicon. (Prior to Rev. A)
*CR1	4036748-P7	Silicon. (Changed at Rev. A)
		- - - - - - - -JACKS AND RECEPTACLES - - - - - - -
J2	19A115862-P1	Receptacle,coaxial: sim to Automatic Metal Products RF-0276-1. (Used in Groups 1, 2, 4, 5 and 6.
*J2	19A115862-P2	Receptacle, coaxial: sim to Automatic Metal Products RF-0276-2. (Used in Group 3)
J3	7776570-P7	Connector, BNC: Receptacle; sim to Military UG-290A/U.
		- - - - - - - - - - - -PLUGS - - - - - - - - - - -
P14	19B209409-P2	Plug: 4 male contacts; sim to Winchester M4P-LSH10.

PRINCIPLES OF [redacted] I-13514D(1)

LOCAL OSCILLATOR
PL-19C306810-G1 thru G5, G7, G8, G9

GENERAL

The local oscillator assembly consists of a solid-state oscillator attached to a box that contains the modulation circuitry. Oscillator frequency is adjusted both mechanically and electrically; it is adjusted to the desired frequency by the mechanical adjustment and automatic frequency control is achieved by the electrical adjustment which is controlled by the AFC voltage applied to it. Oscillator output is applied to the mixer waveguide assembly through a ferrite isolator. The local oscillator assembly is mounted on the receiver shelf.

SPECIFICATIONS

Common Carrier Band (Group 1, 7 & 9):	5855 to 6495 MHz Group 9 with filter
PSIT Band (Group 2 & 8):	6505 to 6945 MHz A low pass filter (FL1) is connected in series to the RF output.
Government Band (Group 3):	7055 to 7500 MHz
Government Band (Group 4):	7500 to 8000 MHz
Government Band (Group 5):	8000 to 8470 MHz
Supply Voltage:	-24 Vdc

DESCRIPTION

The solid-state oscillator contains an oscillator, a varactor diode, a multiplier, and wide bandpass filter. The oscillator is a transistor with a cavity resonator that operates in the 1200 to 1400 MHz range. The oscillator is coupled into a step recovery diode. This device serves as a multiplier due to the signal rich in harmonics produced by the introduction of its characteristic step function. A wide bandpass filter serves to select the desired operating band of frequencies from the signal. The oscillator is tuned to the desired frequency within this band by a mechanical tuning adjustment that changes the effective length of the oscillator cavity. It is tuned electrically by the AFC voltage. The output of the oscillator is

applied to the mixer through a ferrite isolator. The operating potential required by the oscillator and the AFC voltage are applied through the modulation circuitry. Refer to Elementary Diagrams 19C313498 sheet 1 for groups 1, 3, 4, 5, & 7; sheet 2 for groups 2, 8, & 9 and L9B217784 for groups 1 thru 5, 7 & 8.

In groups 7, 8 and 9 the coaxial isolator is not used.

The local oscillator operates from the -24 volt source connected to P13-A. The -20 volt input required by the oscillator is set by adjustment of L.O. VOLT ADJ control R6 so a reading of 20 volts is obtained on a meter connected from TP1 to ground. Zener diodes VR1 and VR2 protect the oscillator from any surges in excess of 24 volts that may occur.

AFC voltage is applied to the oscillator through P13-B, R1, R2 and P1. Upper and lower limits on this voltage are imposed by a clamping circuit. This is the series-parallel network formed by VR4 R4, R5, R3, VR3 which is connected from the -24 volt source to ground, and diodes CR1 and CR2. Resistors R3 and R4 are adjusted to limit the range of frequency adjustment to 4 MHz above and below the desired oscillator frequency. A test modulation signal from an external source can be applied to the oscillator through jack J2 and C4.

When a RF fade produces a receiver squelch, the receiver AFC loses its frequency reference and is no longer functional. To prevent local oscillator frequency drift when the receiver squelch, the AFC voltage is clamped to its midrange value during receiver squelch. To provide this squelch clamping function, the noise amplifier/comparator squelch gate is applied to P13-D which connects to R8, Q1, VR5, R7 and R9. For the normal (non squelched) condition the squelch gate voltage is less than .3 volts dc which causes Q1 to be in the inoperative condition. During squelch the voltage applied to P13-D is approximately -24 volts dc, which causes Q1 to conduct, and in turn clamps the AFC output to the reference voltage produced by VR5.

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MAINTENANCE

LOCAL OSCILLATOR
PL-19C306810G1 THUR -G8

GENERAL

Bench maintenance procedures for the receiver local oscillator consist of: (1) dc voltage measurements and (2) oscillator frequency and power measurements. The voltage measurements check the upper and lower AFC voltage reference levels which determine the upper and lower frequency limitations. They also assure that the correct dc voltages are provided to the local oscillator. Oscillator frequency and power measurements are made through an isolator connected to the output of the oscillator.

Regulated -24 ±0.5 Vdc source voltage at 200 mA is required.

Refer to elementary diagrams 19C313498 sheet 1 for groups 1, 3, 4, 5 & 7, sheet 2 for groups 2 & 8 and sheet 3 for group 6, and 19B217784 for groups 1 thru 8 for the circuit diagram and to drawing 19C315323 for the service outline. The service outline may be used for the location and identification of controls, test points, and E pins.

TEST EQUIPMENT REQUIRED (or equivalent)

Test equipment required for the maintenance of the local oscillator is listed in figure 1.

TEST EQUIPMENT	MODEL	REQUIREMENT
Frequency Counter (Systron-Donner)	1017	8.5 GHz (G1 - G5, G7, G8) 12.0 GHz (G6)
Isolator (General Electric)	19B208401-P1 PSIT & C.C: 19B208401-P2 GOV'T	
Multimeter (Simpson)	260	
Power Meter (Hewlett-Packard)	431B or 432A	10 Milliwatts
Thermistor Mount (Hewlett-Packard)	478A(G1-G5,G7,G8) M-486A(G6)	
Power Supply (Hewlett-Packard)	721A	24 Vdc at 200 mA

Figure 1. Test Equipment Required.

MAINTENANCE PROCEDURES

DC VOLTAGE MEASUREMENTS

(1) Connect test equipment as illustrated in figure 2.

(2) Adjust 500 ohm potentiometer full cw.

(3) Turn power supply on and set output voltage to -24 ±0.5 Vdc.

(4) On local oscillator, set R4 full cw.

(5) Connect multimeter across pin E3 and ground. Multimeter should indicate -6.7 Vdc or less.

(6) Adjust R4 full ccw. Multimeter should indicate -19 Vdc or greater.

(7) Adjust 500 ohm potentiometer in test setup full ccw.

(8) On local oscillator adjust R3 full cw. Multimeter should indicate -0.5 Vdc or less.

(9) On local oscillator, adjust R3 full ccw. Multimeter should indicate -4.2 Vdc or greater.

(10) Connect multimeter across TP1 and ground. Adjust R6 to -20 Vdc.

OSCILLATOR FREQUENCY AND POWER (Fairchild Unit)

(1) Adjust 500 ohm potentiometer in test setup to -4.9 Vdc at E3 on local oscillator.

(2) Connect isolator (GE-19B208401) and frequency counter to A3J1 (output of Fairchild Unit).

(3) Adjust oscillator tuning screw for local oscillator center frequency ±0.5 MHz.

(4) Connect multimeter to E2 and adjust 500 ohm potentiometer to -20 Vdc.

(5) Adjust R4 on local oscillator to obtain a frequency reading of 4.0 MHz ±200 kHz for G1-G5, 6.0 MHz ±200 kHz for G6, above center frequency.

(6) Adjust 500 ohm potentiometer in test setup full ccw.

(7) Adjust R3 on local oscillator to obtain a frequency reading of 4.0 ±200 kHz for G1-G5, 6.0 MHz ±200 kHz for G6, below center frequency. Readjust 500 ohm potentiometer for -4.9 Vdc at E3 on local oscillator.

(8) Disconnect frequency counter.

(9) Using a thermistor mount connect power meter to isolator. Power output should be 5.4 milliwatts or greater for groups 1 thru 5 and 10 milliwatts or greater for group 6.

(10) Disconnect test equipment.

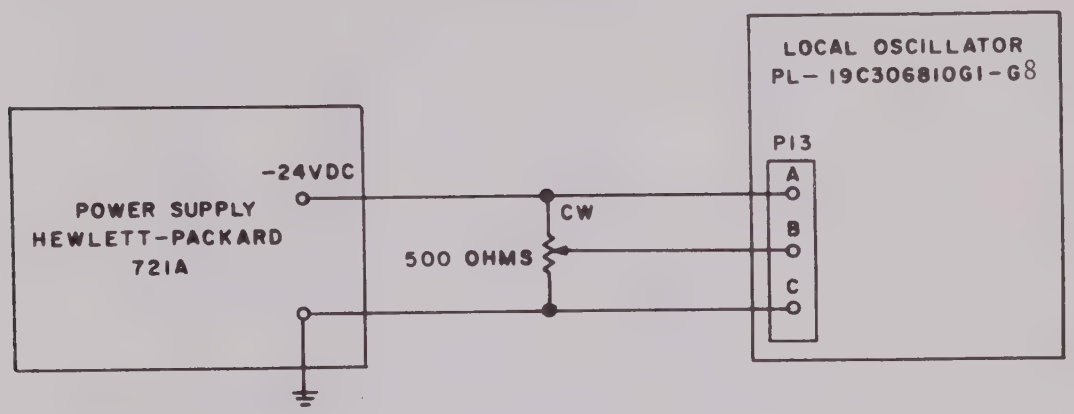

Figure 2. Local Oscillator Test Setup Diagram

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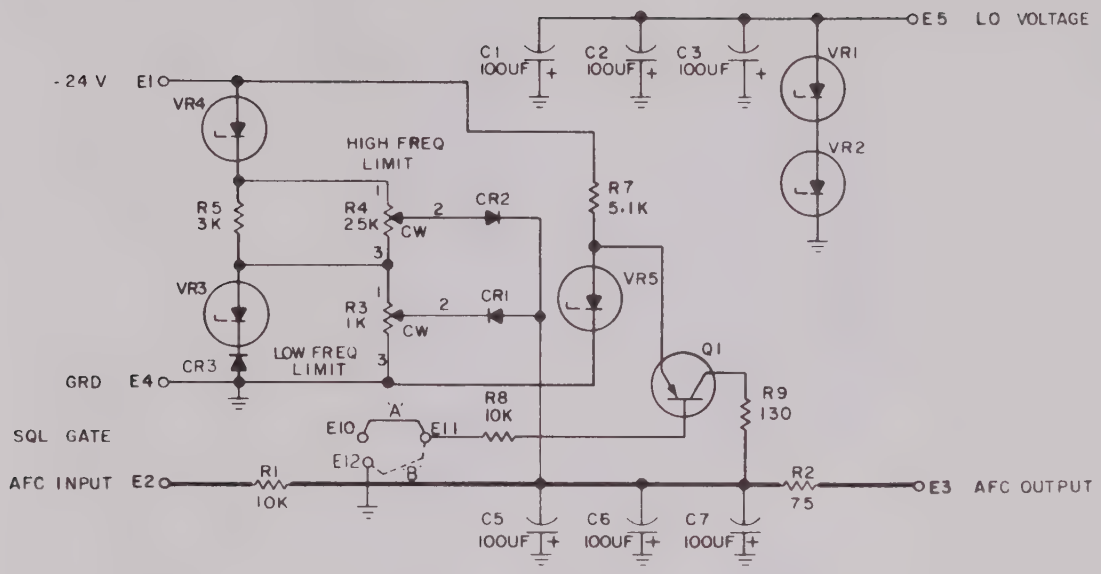


NOTE:
UNIT IS WIRED FOR OPERATION WITH SQUELCH GATE (REVISION A OR LATER).
WHEN UNIT IS USED TO REPLACE A UNIT WITHOUT SQUELCH GATE (REVISION 0), REMOVE THE JUMPER 'A' AND ADD JUMPER 'B'

SEMI-CONDUCTOR CHART

ITEM NO	GE IDENT NO	SIMILAR TO * JEDEC REG NO
CR1,CR2 & CR3	4038056 P1	
VR1 & VR2	19A115528 P4	
VR3	4036887 P4	
VR4 & VR5	4036887 P4	
Q1	19A115852 P1	2N3906

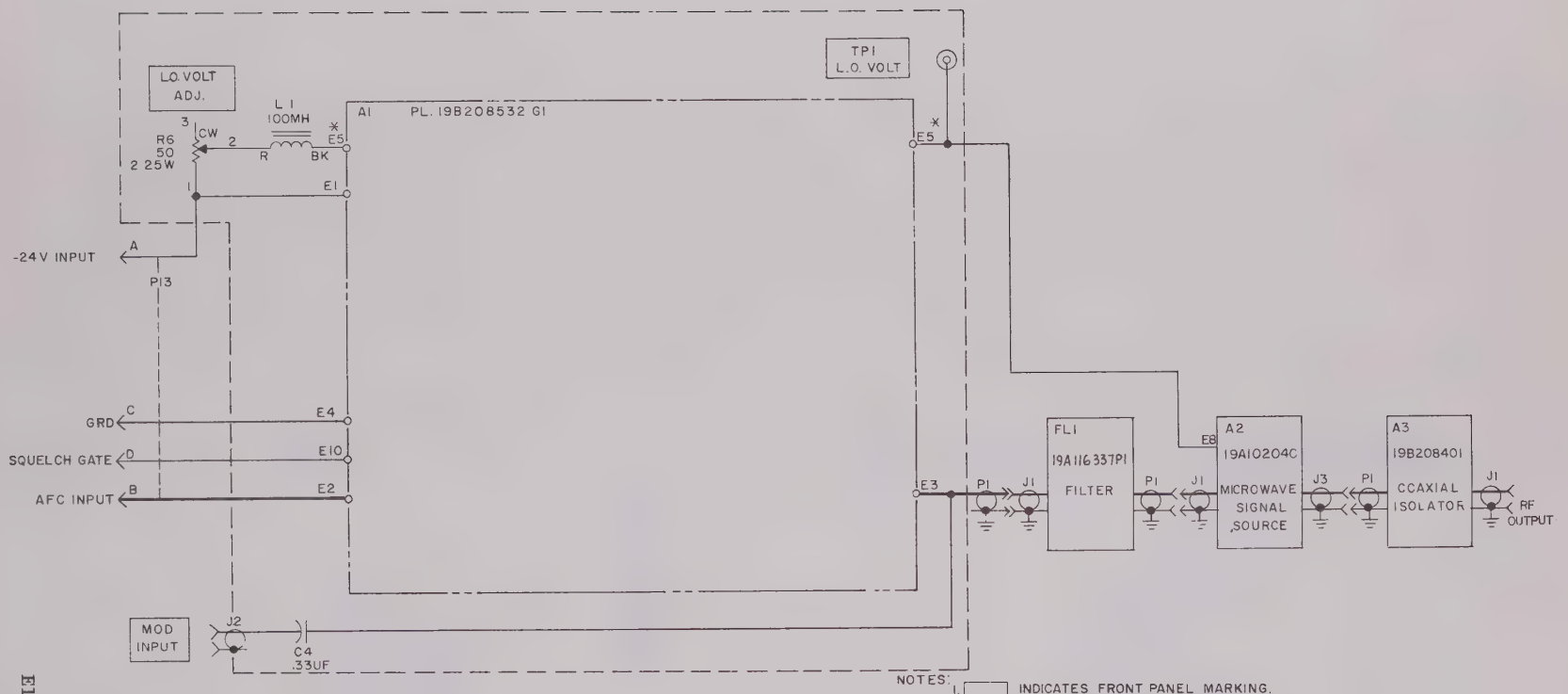
* FOR REFERENCE ONLY NOT RECOMENDED FOR EXACT REPLACEMENT.

ALL RESISTORS ARE 1/2 WATT UNLESS OTHERWISE SPECIFIED AND RESISTOR VALUES IN OHMS UNLESS FOLLOWED BY K=1000 OHMS OR MEG = 1,000,000 OHMS. CAPACITOR VALUES IN PICOFARADS (EQUAL TO MICROMICROFARADS) UNLESS FOLLOWED BY UF = MICROFARADS. INDUCTANCE VALUES IN MICROHENRYS UNLESS FOLLOWED BY MH = MILLIHENRYS OR H = HENRYS.

Elementary Diagram

LOCAL OSCILLATOR BOARD
PL-19B208532

(Drawing No. 19B217784, Rev. 2)



NOTES:

1. [ ] INDICATES FRONT PANEL MARKING.
2. SUBASSEMBLY REFERENCE DESIGNATIONS ARE ABBREVIATED. PREFIX THE DESIGNATION WITH SUBASSEMBLY DESIGNATION.
3. ALL RESISTORS ARE 1/2 WATT UNLESS OTHERWISE SPECIFIED AND RESISTOR VALUES IN OHMS UNLESS FOLLOWED BY K=1000 OHMS. OR MEG=1,000,000 OHMS. CAPACITOR VALUES IN PICOFARADS (EQUAL TO MICROMICROFARADS) UNLESS FOLLOWED BY UF= MICROFARADS. INDUCTANCE VALUES IN MICROHENRYS UNLESS FOLLOWED BY MH= MILLIHENRYS OR H= HENRYS.
4. * DUPLICATED TERMINAL

PL19C306810 GP. IDENTIFICATION

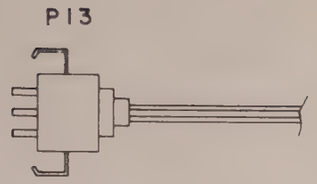
GP	FREQ. RANGE
2	PSIT 6505 -- 6945 MHz
8	PSIT 6505 — 6945 MHz
9	CC 5855 —— 6495 MHz

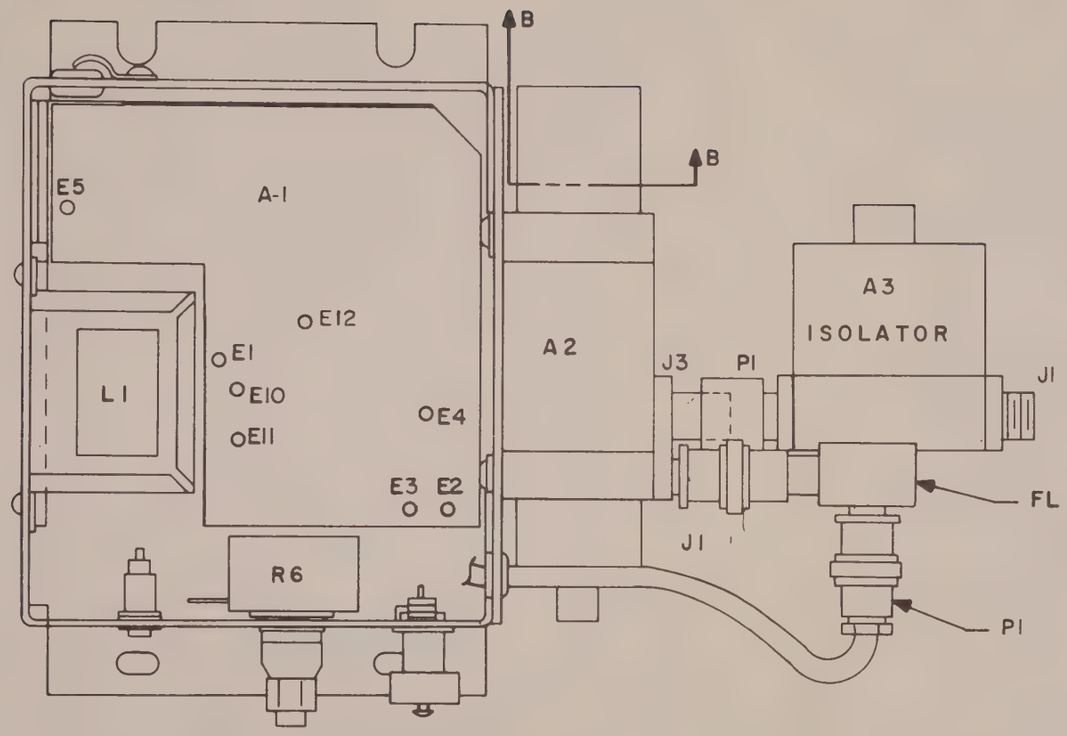
Elementary Diagram

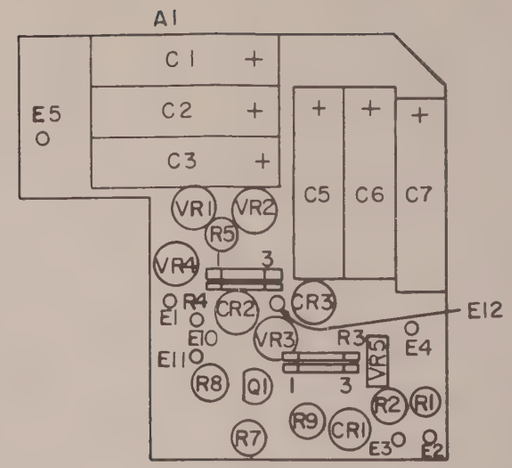
LOCAL OSCILLATOR

PL-19C306810-G2, G8 & G9

(Drawing No. 19C13498, Sh. 2, Rev. 3)

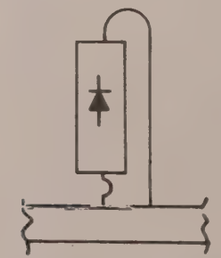




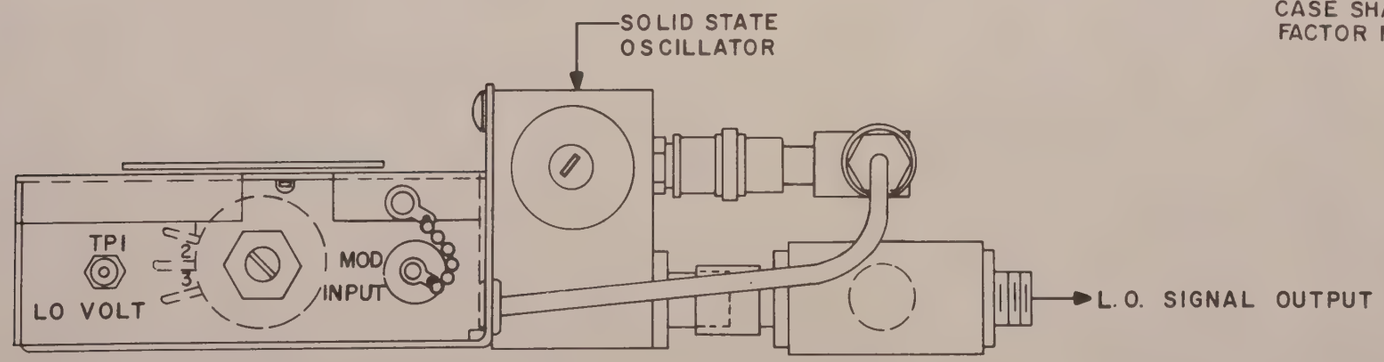


IN-LINE
VIEW FROM LEAD END

LEAD ARRANGEMENT, AND NOT CASE SHAPE, IS DETERMINING FACTOR FOR LEAD IDENTIFICATION.



POLARITY FOR ALL STAND UP DIODES



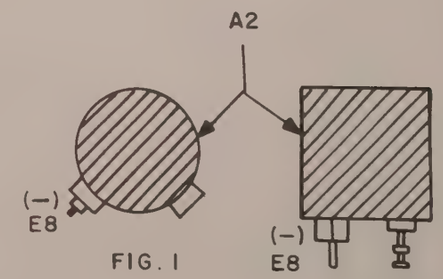


FIG. 1

FIG. 2

NOTE: 1- FL1 USED IN GROUP 2 ONLY.
2-A2 & A3 NOT USED IN GROUP 6.

SECTION B-B

MAY BE EITHER FIG. 1 OR FIG. 2 DEPENDING ON CONFIGURATION OF A2

Service Outline

LOCAL OSCILLATOR
PL-19C306810-G1 thru G6, REV. A

(Drawing No. 19C315323, Rev. 2)

PRODUCTION CHANGE SHEET

LOCAL OSCILLATOR
PL-19C306810-G1 thru -G5

PL-19C306810-G1 thru -G5, REV. A

The following changes were made to component board A1: specifications for diodes CR1 and CR2 were changed, the value of resistor R5 was changed, resistors R7, R8, R9 and diode VR5 were added.

PARTS LIST CHANGES

Symbol	GE Part No.	Description
Change CR1 and CR2 to:		
CR1 & CR2	4038056-P1	Germanium
Change R5 to:		
R5	3R77-P302J	Composition: 3000 ohms ±5%, 1/2 w.
Add:		
R7	3R77-P512J	Composition: 5100 ohms ±5%, 1/2 w.
R8	3R77-P103J	Composition: 10000 ohms ±5%, 1/2 w.
R9	3R77-P131J	Composition: 130 ohms ±5%, 1/2 w.
VR5	4036887-P4	Silicon Zener

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PARTS LIST

LOCAL OSCILLATOR
19C306810-G1 thru G5 REV. A
19C306810-G7, G8, G9
19C306810-G6

SYMBOL	GE PART NO.	DESCRIPTION
		- - - - - - - - - -CAPACITORS- - - - - - - - - -
C4	5491189-P9	Polyester: 0.33 µf ±20%, 50 VDCW.
		- - - - - - - -JACKS AND RECEPTACLES - - - - - - - -
J2	7776570-P17	Receptacle, bulkhead: coaxial, 500 v peak. Military Type UG-1094/U.
		- - - - - - - - - -PLUGS - - - - - - - - - - - -
P1	7776570-P1	Cable plug.
P13	19B209409-P2	Connector, plug: 4 male pins.
		- - - - - - - - - -INDUCTORS - - - - - - - - - - -
L1	19B200777-P1	Reactor: 0.1 h min, 12 ohms ±10%, DC res, 300 Vdc operating.
		- - - - - - - - - -RESISTORS - - - - - - - - - - -
R6	2R73-P1	Variable, composition: 50 ohms ±20%, 2.2% w; sim to Allen-Bradley Type J.
		- - - - - - - - - - TEST POINTS - - - - - - - - - -
TP1	5490384-P6	Jack, tip: yellow nylon; sim to EF Johnson 105.
		- - - - - - - - - - SUB ASSEMBLY - - - - - - - - - -
A1		COMPONENT BOARD 19B208532-G1
		- - - - - - - - - - -CAPACITORS- - - - - - - - - - -
C1 thru C3	19A115680-P12	Electrolytic: 100 µf +150% -10%, 30 VDCW; sim to Mallory Type TT.
C5 thru C7	19A115680-P12	Electrolytic: 100 µf +150% -10%, 30 VDCW; sim to Mallory Type TT.
		- - - - - - -DIODES AND RECTIFIERS - - - - - - - -
CR1 and CR2	19A115250-P1	Silicon. (Prior to Rev. A)
*CR1 and CR2	4038056-P1	Germanium. (Changed at Rev. A)
*CR3	4038056-P1	Germanium. (Added at Rev. A)
		- - - - - - - - - -TERMINALS - - - - - - - - - -
E1 thru E5	19A115296-P1	Terminal, stud.
		- - - - - - - - - TRANSISTORS- - - - - - - - - -
*Q1	19A115852-P1	Silicon, PNP; sim to Type 2N3906. (Added at Rev. A).
		- - - - - - - - - -RESISTORS - - - - - - - - - - -
R1	3R77-P103J	Composition: 10,000 ohms ±5%, 1/2 w.
R2	5495948-P85	Deposited carbon: 75 ohms ±1%, 1/2 w; sim to Texas Instrument CD1/2MR.
R3	19B209358-P103	Variable, carbon film: approx 25 to 1000 ohms ±20%, 0.2 w; sim to CTS Type X-201
R4	19B209358-P104	Variable, carbon film: approx 50 to 2500 ohms ±20%, 0.2 w; sim to CTS Type X-201.
R5	3R152-P302J	Composition: 3000 ohms ±5%, 1/4 w. (Prior to Rev. A).
*R5	3R77-P302J	Composition: 3000 ohms ±5%, 1/2 w. (Changed at Rev. A)
*R7	3R77-P512J	Composition: 5100 ohms ±5%, 1/2 w. (Added at Rev. A)
*R8	3R77-P103J	Composition: 10,000 ohms ±5%, 1/2 w. (Added at Rev. A).
*R9	3R77-P131J	Composition: 130 ohms, ±5%, 1/2 w. (Added at Rev. A).
		- - - - - - - VOLTAGE REGULATORS- - - - - - - - -
VR1 and VR2	19A115528-P4	Silicon, Zener
VR3 and VR4	4036887-P5	Silicon, Zener.
*VR5	4036887-P4	Silicon, Zener.
		- - - - - - - - SUB ASSEMBLIES- - - - - - - - - -
A2	19A102040-P1	Microwave Signal Source: 5855 to 6495 MHz freq range. (Used in G1 only).
A2	19A102040-P2	Microwave Signal Source: 6505 to 6945 MHz freq range. (Used in G2 only).
A2	19A102040-P3	Microwave Signal Source: 6805 to 7195 MHz freq range. (Used in G3 only).
A2	19A102040-P4	Microwave Signal Source: 7055 to 7500 MHz freq range. (Used in G4 only).
A2	19A102040-P5	Microwave Signal Source: 7500 to 8000 MHz freq range. (Used in G5 only).
A2	19A102040-P7	Microwave Signal Source: 5855 to 6495 MHz freq range: (Used in G7 & G9 only).
A2	19A102040-P8	Microwave Signal Source: 6505 to 6945 MHz freq range. (Used in G8 only).
A3	19B208401-P1	Isolator: freq range 5850 to 6950 MHz (Used in G1 and G2).
A3	19B208401-P2	Isolator: freq range 7050 to 8500 MHz. (Used in G3 thru G5).
FL1	19A166337-P1	Low Pass Filter: (Used in G2, G8 & G9 only).

*COMPONENTS ADDED, DELETED OR CHANGED BY PRODUCTION CHANGES

RECEIVER AFC AMPLIFIER
PL-19C306678-G1

2.0 GENERAL

2.0.1 The AFC error voltage from the discriminator is applied to the AFC amplifier unit. The output of the amplifier is a voltage used to tune the local oscillator so a constant 70 MHz difference between it and the incoming signal frequency will be maintained.

2.0.2 The amplifier circuit consists of a two-stage differential amplifier followed by a single-stage direct-coupled amplifier. Input signal is applied to the differential amplifier through a switching circuit. The switching circuit is used to turn the AFC on and off and to connect the rack meter into the AFC circuit to monitor its function during adjustment and operation. The unit is located on the rear of the inner door mounted to the receiver door assembly.

2.1 SPECIFICATIONS

Overall gain:	approximately 2200
Supply voltages:	-24 vdc
	+24 vdc

2.3 DESCRIPTION

2.3.1 The receiver AFC amplifier circuit is described in three parts as follows: (1) metering circuit, (2) AFC bias circuit, and (3) AFC amplifier circuit. Refer to Elementary Diagram 19D405342.

2.3.2 METERING CIRCUIT

2.3.2.1 The AFC error voltage from the discriminator is applied to terminal E46, and when the meter selector switch on front of the receiver door is in its AFC position, the rack meter is connected to selector switch S1 at terminals E76 and E77. A description of the circuit for each of the four positions of selector switch S1 follows.

2.3.2.2 METER ZERO: The meter is connected across R2 and R3 through S1A-1, S1B-1 and S1A-7. Resistors R2 and R3 are part of a series-parallel network formed by R1, R2, R3, R8, R9, R11 and R14 that is connected to the -24 volt source on one side and a +21 volt source on the other. The AFC loop is open and the input to the amplifier circuit is grounded through S1B-7 and R7. METER ZERO control R1 is adjusted to obtain a reading of zero on the bottom scale.

2.3.2.3 OFF: The meter is connected to the -24 volt source through S1A-2, R1 and R11; to a +21 volt source at the divider formed by R14 and R9 through S1A-8; and to the AFC error voltage through E46, R6 and S1B-2. The AFC loop is open and the input to the amplifier circuit is grounded through S1B-8 and R7. The meter indicates relative frequency; zero on the bottom scale represents the on-frequency condition.

2.3.2.4 RANGE: The meter is connected to ground through S1A-9, and to AFC output terminal E48 through R36, R37, and S1A-3. The AFC loop is open and the input to the amplifier circuit is grounded through S1B-9 and R7. This position provides the metering needed to set AFC output in the center of its range. Since the range of voltage at E48 exceeds the range of the meter, resistors R38, R39 and diode CR1 serve to limit the voltage applied to the meter.

2.3.2.5 ON: The meter is connected to the -24 volt source through S1A-4, R1 and R11; to a +21 volt source at the divider formed by R14 and R9 through S1A-10; and to the AFC error voltage through E46, R5 and S1B-4. The AFC loop is closed and the error voltage at E46 is applied to the amplifier circuit through S1B-10. THIS IS THE NORMAL POSITION OF SWITCH S1. The meter indicates relative frequency, and should indicate to zero on the bottom scale when AFC is operating.

2.3.3 AFC BIAS CIRCUIT

2.3.3.1 The dc level of the error voltage from the discriminator is adjusted around zero by the application of a bias voltage. This voltage is furnished by the circuit consisting of zener diodes VR5, VR6 and resistors R31, R32 and R35. Zener diode VR5 is connected to the -24 volt source through R31 and VR6 is connected to the +24 volt source through R35. The adjustable bias voltage is taken from AFC BIAS control R32 which is connected between VR5 and VR6. This voltage is applied to the error voltage from the discriminator at E46 through R33.

2.3.4 AFC AMPLIFIER CIRCUIT

2.3.4.1 The amplifier circuit consists of two-stage differential amplifier Q1, Q2, Q3, Q4 and single-stage direct-coupled amplifier Q5. When selector switch S1 is in its ON position the AFC error voltage at E46 is applied through S1B-10 to the base of Q2 or Q4 depending on which of two pairs of jumpers ("A" and "B" or "C" and "D") are in place. If local oscillator frequency is below the received signal frequency, jumpers "A" and "B" are used, so input signal is applied to the base of Q4 and the base of Q2 is grounded through R10. Jumpers "C" and "D" are used when the local oscillator is above the received signal frequency; the input signal is then applied to the base of Q2 and the base of Q4 is grounded through R10. Note that transistors Q2 and Q4, which form the first stage of the two-stage differential amplifier, are a matched pair designated as Z1. The second stage is formed by Q1 and Q3. The output of the differential amplifier is taken from the collector of Q3 and is applied to the base of Q5 through R24, R25. The output of Q5 is applied to the local oscillator through E48. The dynamic range of AFC output at E48 is 0 to -20 volts. The normal output is -4.9 volts.

2.3.4.2 Three controls are associated with the differential amplifier. The LO FREQ ADJ and AFC GAIN ADJ controls (R19 and R16 respectively) are in the emitter circuit of output stage Q1, Q3. BAL ADJ control R22 is in the emitter circuit of input stage Q2, Q4. Overall amplifier gain is set to approximately 2200 by a factory adjustment of the AFC GAIN ADJ control. The normal AFC output at E48 is set

to -4.9 volts by turning selector switch S1 to its RANGE position and adjusting the LO FREQ ADJ control to obtain a mid-scale deflection of the rack meter. The BAL ADJ control is used to compensate for imbalances within the differential amplifier. When a volt-ohmmeter is connected to BALANCE test points TP1 and TP2, the control is adjusted to obtain a voltage null on the most sensitive voltage scale, thus assuring that the collector voltages of output stage Q1, Q3 are equal. THE BALANCE AND LO FREQUENCY ADJUSTMENTS ARE INTERRELATED; Therefore the adjustment of one will require the checking of the other.

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MAINTENANCE

RECEIVER AFC AMPLIFIER
PL-19C306678-G1

2.6.5 GENERAL

2.6.5.0 Bench maintenance procedures for the Receiver AFC amplifier unit consist of : (1) AFC balance and LO frequency adjustment, (2) DC voltage measurements, (3) meter calibration, and (4) AFC amplifier gain and balance adjustment. DC voltage measurements are taken at selected points in the AFC Amplifier. The resultant voltage readings provide a good indication of the static dc operation of all circuits and will serve as a troubleshooting aid to quickly isolate a malfunction. Typical dc voltage readings are included in the maintenance procedures. The AFC balance and local oscillator frequency adjustments check the dc operation of the balance circuits and set the AFC signal level for the local oscillator. R22 adjusts for the correct balance voltage while R19 is used to adjust the local oscillator frequency. The AFC gain and balance procedure checks both the amplifier gain and balance voltage for both positive and negative error voltages. The maintenance procedures must be performed in the sequence given

2.6.5.0.1 Both positive and negative 24 vdc source voltages at 40 ma regulated are required.

2.6.5.0.2 Refer to elementary drawing 19D405342 for the circuit diagram and to drawing 19C315290 for the service outline. The service outline may be used for location and identification of controls, E pins and components. The test setup required is illustrated in figure 2.

2.6.5.1 TEST EQUIPMENT REQUIRED (or equivalent)

2.6.5.1.0 Test equipment required for maintenance for the receiver AFC amplifier is listed in figure 1.

TEST EQUIPMENT	MODEL	REQUIREMENT
DC Voltmeter (2) (Hewlett-Packard)	412A	Zero center
Power Supply (2) (Hewlett-Packard)	421A	
Meter (General Electric)	GE-19A115908-1	
Components		Figure 2

Figure 1. Test Equipment Required.

2.6.5.2 MAINTENANCE PROCEDURES

2.6.5.2.1 AFC BALANCE AND LO FREQUENCY ADJUSTMENT

(1) Connect test equipment as illustrated in figure 2.

(2) Set switches on test setup as follows: S1 to position 1, S2 to position 1, S3 to position 2.

(3) Turn both power supplies on and adjust output voltages for +24 vdc and -24 vdc operation.

(4) Set the selector switch (S1) to the OFF position.

(5) Adjust dc voltmeter for a center zero reading and connect across BALANCE jacks TP1 and TP2 on the receiver AFC amplifier.

(6) Adjust BAL ADJ control for 0 vdc ±200 millivolts.

(7) With second dc voltmeter connected across TP1 and TP2 on test setup, adjust LO FREQ ADJ to obtain a reading of -4.9 ±0.3 vdc.

(8) Repeat steps 6 and 7 as necessary to satisfy requirements of steps 6 and 7.

2.6.5.2.2 METER CALIBRATION

(1) Set selector switch to METER ZERO.

(2) Adjust meter zero control (R1) to obtain a 0 indication ±0.1 large division on the test setup meter.

(3) Set selector switch to RANGE. Meter should indicate 0 ±0.4 large divisions.

2.6.5.2.3 DC VOLTAGE MEASUREMENTS

NOTE

Paragraph 2.6.5.2.1 and 2.6.5.2.2 must be performed prior to making voltage measurements.

(1) Set AFC switch to OFF and make dc voltage measurements listed in figure 3 . All voltages are measured with respect to ground.

2.6.5.2.4 AFC AMPLIFIER GAIN AND BALANCE

(1) Set AFC gain adjust control full clockwise.

(2) Set selector switch to ON and adjust AFC BIAS control to obtain -4.9 vdc across TP1 and TP2 on test setup.

TEST POINT	DC VOLTAGE	TEST POINT	DC VOLTAGE
Q2; Q4; collector	-6.5 ±1.5	Junction R14, R23	+20.5 ±1
Q2; Q4; emitter	+0.6 ±0.2	Junction R15, R20	-8.5 ±1.5
Q1; Q3; collector	+2.4 ±0.8	Junction R31, VR5	-5.4 ±0.3
Q1; Q3; emitter	-6.8 ±1.5	Junction R35, VR6	+5.4 ±0.3
Q5; emitter	+3.5 ±0.8	SI B-6	0 ±0.1
Q5; collector	-4.9 ±0.5	Junction R36, R37	-2.2 ±0.3
Junction R27, R30	-21.6±1		

Figure 3. DC Voltage Measurements (Typical)

2.6.5.2.4 AFC AMPLIFIER GAIN AND BALANCE

(1) Set AFC gain adjust control full clockwise.

(2) Set selector switch to ON and adjust AFC BIAS control to obtain -4.9 vdc across TP1 and TP2 on test setup.

(3) Set S3 on test setup to position 1. The output voltage across TP1 and TP3 on test setup should be greater than -12.2 vdc.

(4) Set S1 on test setup to position 2. The output voltage across TP1 and TP2 should now be greater than +0.2 vdc.

(5) Set S2 to position 2. The output voltage across TP1 and TP2 on test setup should be greater than +1.0 vdc.

(6) Set S1 to position 1. The output voltage across TP1 and TP2 on test setup should be greater than -20 vdc.

(7) Set the AFC gain adjust control to its mid position.

(8) Repeat steps 5 through 8 of paragraph 2.6.5.2.1.

(9) Set switches on test setup as follows: S1 to position 1; S2 to position 1; and S3 to position 2. Record voltage reading across TP1 and TP2 on test setup.

(10) Set S3 to position 1 and adjust AFC gain adjust control to obtain a voltage reading across TP1 and TP2 on test setup which is 4.5 ±0.2 vdc greater than that recorded in step (9) above.

(11) Set selector switch to OFF and repeat steps (5) through (8) of paragraph 2.6.5.2.1.

(12) Set selector switch to ON and S3 on test setup to position 2. Record voltage reading across TP1 and TP2 on test setup.

(13) Set S3 to position 1 and adjust AFC gain adjust control to obtain a voltage reading across TP1 and TP2 on test setup which is 4.5 ±0.2 volts greater than that recorded in step (12) above.

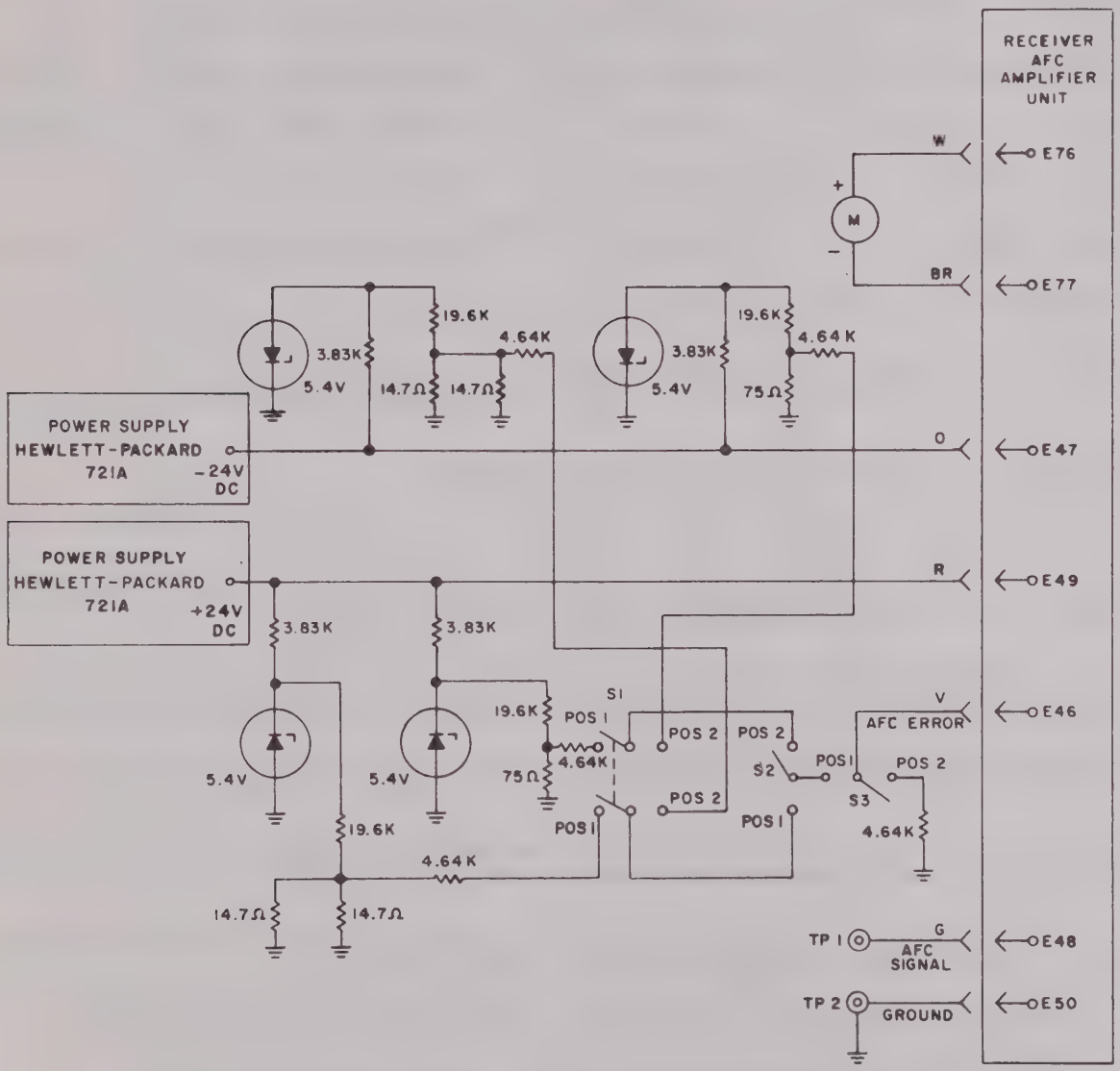
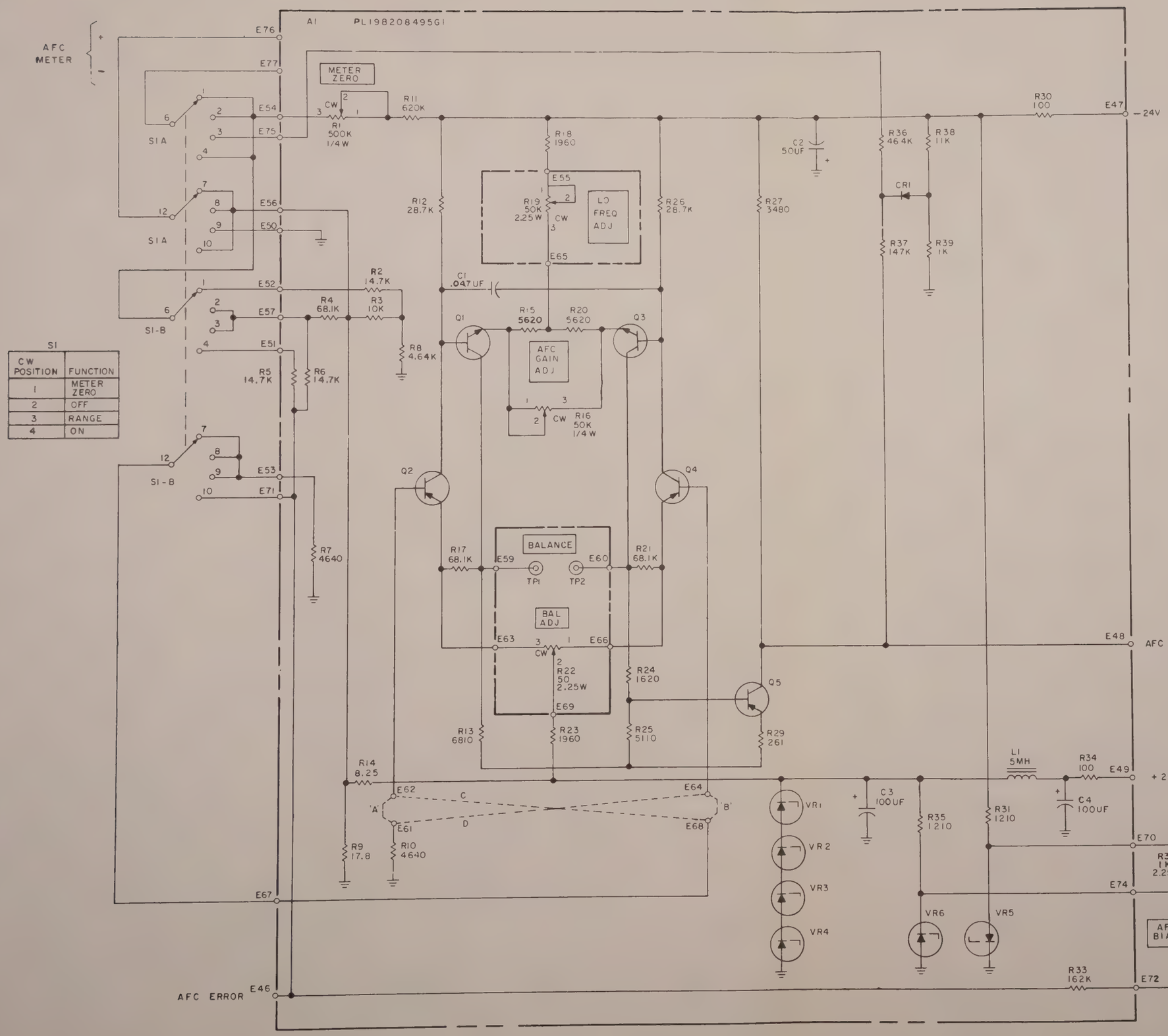


Figure 2. Receiver AFC Amplifier Test Setup Diagram.



S1

CW POSITION	FUNCTION
1	METER ZERO
2	OFF
3	RANGE
4	ON

SEMI-CONDUCTOR CHART

ITEM NO.	GE IDENT. NO	SIMILAR TO * JEDEC REF. NO
A1Q1 & A1Q3	19A115123P1	2N2712
A1Q5	19A115768P1	2N3702
A1CR1	19A115250P1	5SD753
A1VR1, A1VR3-A1VR6	A4036887P5	HR5.4
A1VR2	A4036887P3	
A1Q2 & A1Q4	19A115912P1	

* FOR REFERENCE ONLY NOT RECOMMENDED FOR EXACT REPLACEMENT.

NOTES:

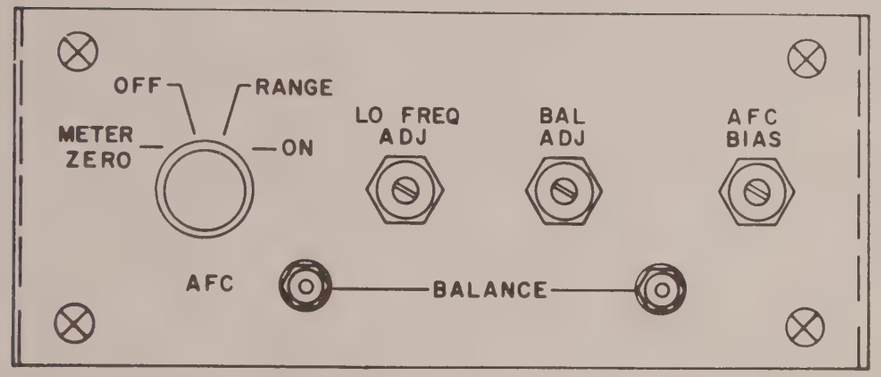
1. ▭ INDICATES PANEL MARKING.
2. JUMPERS 'A' AND 'B' FOR LP FREQUENCY BELOW RECEIVER FREQUENCY. CHANGE JUMPERS 'A' AND 'B' TO 'C' AND 'D' IF LO. FREQUENCY ABOVE RECEIVER FREQUENCY IS DESIRED.
3. REFERENCE DESIGNATIONS ARE ABBREVIATED. PREFIX THE DESIGNATION WITH UNIT NUMBER OR ASSEMBLY DESIGNATION OR BOTH.
4. Q2 AND Q4 ARE MATCHED PAIRS IDENTIFIED BY Z1

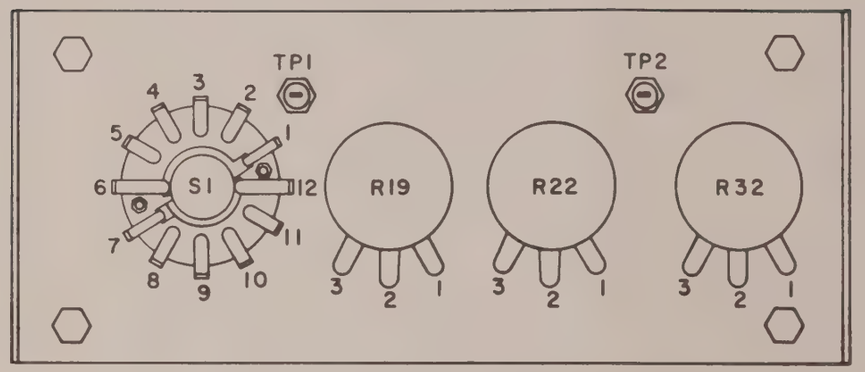
ALL RESISTORS ARE ½ WATT UNLESS OTHERWISE SPECIFIED AND RESISTOR VALUES IN OHMS UNLESS FOLLOWED BY K = 1000 OHMS OR MEG 1,000,000 OHMS. CAPACITOR VALUES IN PICOFARADS (EQUAL TO MICROMICROFARADS) UNLESS FOLLOWED BY UF MICROFARADS. INDUCTANCE VALUES IN MICROHENRYS UNLESS FOLLOWED BY MH MILLIHENRYS OR H HENRYS.

Elementary Diagram

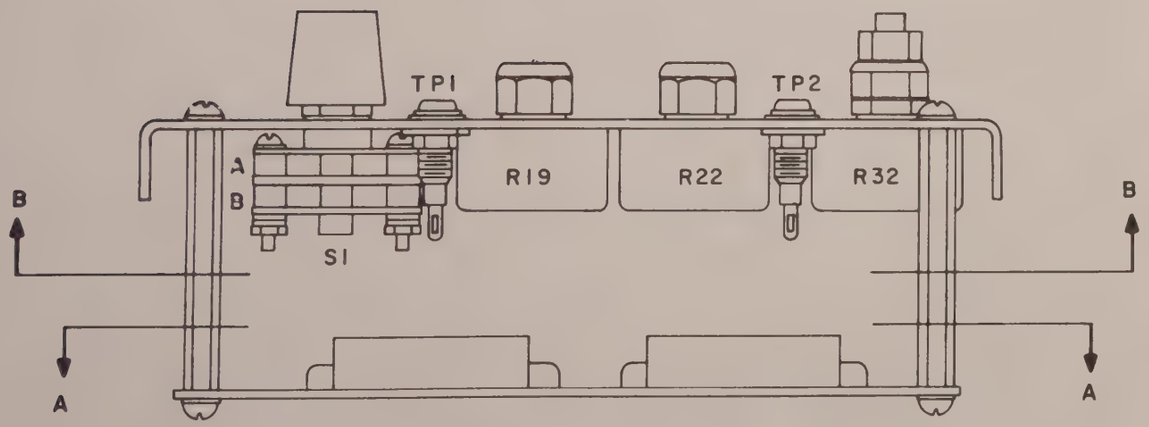
RECEIVER AFC AMPLIFIER
PL-19C306678-G1

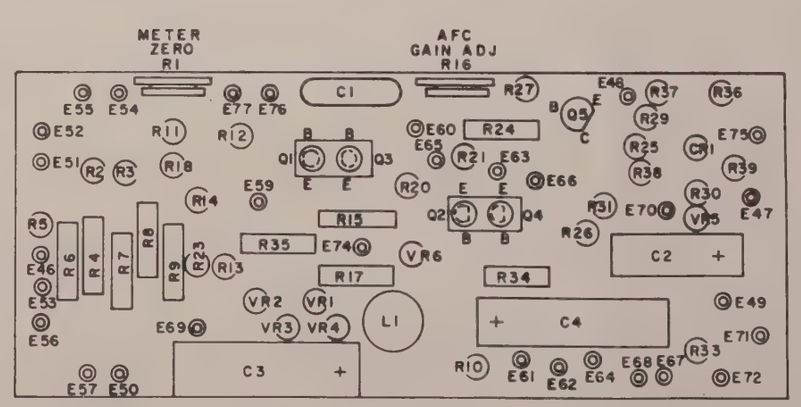
(Drawing No. 19D405342, Rev. 4)



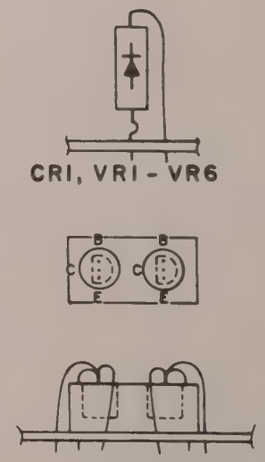


SECTION B–B





SECTION A-A



CR1, VR1 - VR6

TYP MOUNTING FOR Q1, Q2, Q3 & Q4

Service Outline

RECEIVER AFC AMPLIFIER
PL-19C306678-G1

(Drawing No. 19C315290, Rev. 0)

PARTS LIST

RECEIVER AFC AMPLIFIER
19C306678-G1

SYMBOL	G-E PART NO.	DESCRIPTION
		COMPONENT BOARD 19B208495-G1
		- - - - - - - - - - CAPACITORS - - - - - - - - - -
C1	19A115028-P11	Polyester: 0.047 µf ±20%, 200 VDCW.
C2	7489483-P17	Electrolytic: 50 µf +75% -10%, 25 VDCW; sim to Sprague 30D.
C3 and C4	19A115680-P12	Electrolytic: 100 µf +150% -10%, 30 VDCW; sim to Mallory Type TT.
		- - - - - - - DIODES AND RECTIFIERS - - - - - - -
CR1	19A115250-P1	Silicon.
		- - - - - - - - - - TERMINALS - - - - - - - - - -
E46 thru E57	19A115296-P1	Terminal, standoff.
E59 thru E72	19A115296-P1	Terminal, standoff.
E74 thru E77	19A115296-P1	Terminal, standoff.
		- - - - - - - - - - INDUCTORS - - - - - - - - - -
L1	7491382-P110	Coil, RF: 5000 µh ±10%, 78 ohms DC res max; sim to Delevan 3500 Series.
		- - - - - - - - - - TRANSISTORS - - - - - - - - - -
Q1	19A115889-P1	Silicon, NPN; sim to Type 2N2712.
Q2		Part of Z1.
Q3	19A115889-P1	Silicon, NPN; sim to Type 2N2712.
Q4		Part of Z1.
Q5	19A115768-P1	Silicon, PNP; sim to Type 2N3702.
		- - - - - - - - - - RESISTORS - - - - - - - - - -
R1	19B209358-P111	Variable, carbon film: approx 1000 to 500,000 ohms ±20%, 0.25 w; sim to CTS Type X-201.
R2	5495948-P317	Deposited carbon: 14,700 ohms ±1%, 1/2 w; sim to Texas Instrument CD1/2MR.
R3	5495948-P301	Deposited carbon: 10,000 ohms ±1%, 1/2 w; sim to Texas Instrument CD1/2MR.
R4	5495948-P381	Deposited carbon: 68,100 ohms ±1%, 1/2 w; sim to Texas Instrument CD1/2MR.
R5 and R6	5495948-P317	Deposited carbon: 14,700 ohms ±1%, 1/2 w; sim to Texas Instrument CD1/2MR.
R7 and R8	5495948-P265	Deposited carbon: 4640 ohms ±1%, 1/2 w; sim to Texas Instrument CD1/2MR.
R9	5495948-P25	Deposited carbon: 17.8 ohms ±1%, 1/2 w; sim to Texas Instrument CD1/2MR.
R10	5495948-P265	Deposited carbon: 4640 ohms ±1%, 1/2 w; sim to Texas Instrument CD1/2MR.
R11	3R77-P624J	Composition: 0.62 megohms ±5%, 1/2 w.
R12	5495948-P345	Deposited carbon: 28,700 ohms ±1%, 1/2 w; sim to Texas Instrument CD1/2MR.
R13	5495948-P281	Deposited carbon: 6810 ohms ±1%, 1/2 w; sim to Texas Instrument CD1/2MR.
R14	5495948-P289	Deposited carbon: 8250 ohms ±1%, 1/2 w; sim to Texas Instrument CD1/2MR.
R15	5495948-P273	Deposited carbon: 5620 ohms ±1%, 1/2 w; sim to Texas Instrument CD1/2MR.
R16	19B209358-P108	Variable, carbon film: approx 100 to 50,000 ohms ±20%, 0.25 w; sim to CTS Type X-201.
R17	5495948-P381	Deposited carbon: 68,100 ohms ±1%, 1/2 w; sim to Texas Instrument CD1/2MR.
R18	5495948-P229	Deposited carbon: 1960 ohms ±1%, 1/2 w; sim to Texas Instrument CD1/2MR.
R20	5495948-P273	Deposited carbon: 5620 ohms ±1%, 1/2 w; sim to Texas Instrument CD1/2MR.
R21	5495948-P381	Deposited carbon: 68,100 ohms ±1%, 1/2 w; sim to Texas Instrument CD1/2MR.
R23	5495948-P329	Deposited carbon: 19,600 ohms ±1%, 1/2 w; sim to Texas Instrument CD1/2MR.
R24	5495948-P221	Deposited carbon: 1620 ohms ±1%, 1/2 w; sim to Texas Instrument CD1/2MR.
R25	5495948-P269	Deposited carbon: 5110 ohms ±1%, 1/2 w; sim to Texas Instrument CD1/2MR.
R26	5495948-P345	Deposited carbon: 28,700 ohms ±1%, 1/2 w; sim to Texas Instrument CD1/2MR.
R27	5495948-P253	Deposited carbon: 3480 ohms ±1%, 1/2 w; sim to Texas Instrument CD1/2MR.
R29	5495948-P141	Deposited carbon: 261 ohms ±1%, 1/2 w; sim to Texas Instrument CD1/2MR.
R30	3R77-P101J	Composition: 100 ohms ±5%, 1/2 w.
R31	5495948-P209	Deposited carbon: 1210 ohms ±1%, 1/2 w; sim to Texas Instrument CD1/2MR.
R33	5495948-P421	Deposited carbon: 162,000 ohms ±1%, 1/2 w; sim to Texas Instrument CD1/2MR.
R34	3R77-P101J	Composition: 100 ohms ±5%, 1/2 w.
R35	5495948-P209	Deposited carbon: 1210 ohms ±1%, 1/2 w; sim to Texas Instrument CD1/2MR.
R36	5495948-P365	Deposited carbon: 46,400 ohms ±1%, 1/2 w; sim to Texas Instrument CD1/2MR.
R37	5495948-P417	Deposited carbon: 147,000 ohms ±1%, 1/2 w; sim to Texas Instrument CD1/2MR.
R38	5495948-P305	Deposited carbon: 10,500 ohms ±1%, 1/2 w; sim to Texas Instrument CD1/2MR.
R39	5495948-P201	Deposited carbon: 1000 ohms ±1%, 1/2 w; sim to Texas Instrument CD1/2MR.
		- - - - - - - - VOLTAGE REGULATORS - - - - - - - -
VR1 thru VR6	4036887-P5	Silicon, Zener.
Z1	19A102138-P1	Differential amplifier. Consists of two matched transistors (Q2 and Q4).
		- - - - - - - - - - RESISTORS - - - - - - - - - -
R19	2R73-P58	Variable, composition: 50,000 ohms ±20%, 2.25 w; sim to Allen-Bradley Type J.
R22	2R73-P41	Variable, composition: 50 ohms ±20%, 2.25 w; sim to Allen-Bradley Type J.
R32	2R73-P8	Variable, composition: 1000 ohms ±20%, 2.25 w; sim to Allen-Bradley Type J.
		- - - - - - - - - - SWITCHES - - - - - - - - - -
S1	19C307127-P2	Rotary: 2 sections, 4 poles, 5 positions, non-shorting contacts, 2 amps at 28 VDC or 1 amp at 110 VAC; sim to Oak Type "F".
		- - - - - - - - - - TEST POINTS - - - - - - - - - -
TP1 and TP2	5490384-P6	Jack, tip: yellow nylon; sim to EF Johnson 105.
		- - - - - - - - - - MISCELLANEOUS - - - - - - - - - -
	19A101884-P1	Heat sink. (Used with Q1 and Q3, Q2 and Q4 on Component Board).

*COMPONENTS ADDED, DELETED OR CHANGED BY PRODUCTION CHANGES.

SECTION II

PRINCIPLES OF OPERATION

RECEIVER BASEBAND AMPLIFIER PL-19C306761-G1, G2

2.0 GENERAL

2.0.1 The receiver baseband amplifier is a four-stage fixed gain amplifier. Baseband signal from the discriminator is applied to its input. The amplifier provides amplified baseband signal to local terminal equipment, to the noise detector, to the receiver sensing unit, and to an output monitor jack. The baseband signal to local terminal equipment is squelched when receiver noise exceeds a preset level. The amplifier is constructed on a printed wire board which is located inside a completely enclosed shielding chassis mounted on the inner door assembly.

2.1 SPECIFICATIONS

Input Impedance:	75 ohms
Frequency Response:	300 Hz to 8.5 MHz ±0.1 dB (300 kHz reference)
Baseband Output Impedance:	75 ohms
Supply Voltage:	-24 vdc

2.2 CIRCUIT DESCRIPTION

2.2.1 The amplifier circuit is described with reference to elementary diagram 19C306745 (group 1) or 19C313525 (group 2).

2.2.2 Baseband input signal is applied at terminal E26, and coupled to the base of stage Q1 by C1. Note that a test signal can be applied at J21 when a jumper is connected between terminals E26 and E27.

2.2.3 Transistors Q1 through Q4 form a four-stage direct-coupled amplifier. Overall gain is determined by the feedback network consisting of R6, R10, R11 and RT1 that is connected from the emitter of stage Q3 to the emitter of stage Q1. Variable capacitor C6 is used to adjust frequency response.

2.2.4 The baseband output for group 2 units is taken from stage Q3 through C7, R21, and output terminal E34. The service channel output is present at E36.

2.2.5 The baseband output for group 1 units is taken from stage Q3 through C7, contacts 2-3 on squelch relay K1, R21 and terminal E34, A 2400-ohm output for use in special applications with the Model

4UD12A Service Channel Unit is provided by the connection from contact 3 on K1 through R20 to output terminal E36. Relay K1 is operated by a voltage from the noise detector. When receiver noise exceeds a preset level, the relay is energized and the baseband and special service channel outputs are grounded through relay contacts 1-3.

2.2.6 The sensing, noise detector and monitor outputs are taken from stage Q4. Signal is applied to the sensing circuit through R17 and C10, to the noise detector through R19 and C12, and to output monitor jack J20 through C11 and R18.

COMMUNICATION PRODUCTS DEPARTMENT
GENERAL ELECTRIC COMPANY
LYNCHBURG, VIRGINIA

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MAINTENANCE

RECEIVER BASEBAND AMPLIFIER
PL-19C306761-G1, -G2

2.6.4 GENERAL

2.6.4.0 Bench maintenance procedures for the receiver baseband amplifier consist of: (1) frequency response adjustment and (2) amplifier gain. The frequency response is checked over the range of 300 Hz to 8.5 MHz and should be flat within 0.2 dB. Capacitor C6 is adjusted as necessary to obtain the desired response curve. The frequency response is measured between J21 and E34. The receiver baseband amplifier in effect serves as a distribution amplifier providing approximately 14 dB gain at baseband output terminal E34 and auxiliary output terminals E28, E29, and J20. Amplifier gain is checked at 300 kHz between J21 and J20. The service channel output is available at E36.

2.6.4.0.1 Regulated -24 Vdc source voltage at 200 mA is required to operate the receiver baseband amplifier.

2.6.4.0.2 Test jacks J20 and J21 are provided to facilitate test signal connections. J21 is the input jack for the test signals and J20 the output monitor jack. A jumper wire must be connected from E26 to E27 (input) while performing maintenance and removed immediately thereafter.

2.6.4.0.3 Refer to elementary drawing 19C306745 (PL-19C306761-G1) and to drawing 19C313525 (PL-19C306761-G2) for the circuit diagram and to drawing 19B210875 for the service outline. The service outline may be used for the location and identification of controls, E pins, and components.

2.6.4.1 TEST EQUIPMENT REQUIRED (or equivalent)

2.6.4.1.0 Test equipment required for maintenance of the receiver baseband amplifier unit is listed in figure 1. The test setup is illustrated in figure 2.

TEST EQUIPMENT	MODEL	REQUIREMENT
AC Voltmeter (Hewlett-Packard)	400EL	9 MHz
Adapter	BNC	"Tee"
Multimeter (Simpson)	260	
Power Supply (Hewlett-Packard)	721A	-24 Vdc at 200 mA
Test Oscillator (Hewlett-Packard)	651B-02	9 MHz

Figure 1. Test Equipment Required (or equivalent)

2.6.4.2 MAINTENANCE PROCEDURES

2.6.4.2.1 FREQUENCY RESPONSE

(1) On receiver baseband amplifier, connect jumper wire between E26 and E27.

(2) Connect test equipment as illustrated in figure 2.

(3) Turn power supply on and adjust output voltage to -24 Vdc.

(4) Using multimeter measure dc voltage at Q3 emitter. Voltage should be a nominal -10 Vdc.

(5) Turn test oscillator on and set frequency to 300 kHz and output level to -29 dBm.

(6) The ac voltmeter should indicate -14.7 ±0.5 dBm at E34.

NOTE

Capacitor C6 controls the frequency response at the high end; adjust as necessary.

(7) Maintain the output level of test oscillator constant while varying the frequency from 300 Hz to 8.5 MHz. The output level should remain constant within the limits of -14.7 ±0.5 dBm. Adjust C6 as necessary.

2.6.4.4 AMPLIFIER GAIN

(1) Set frequency of test oscillator to 300 kHz and the output level to -29 dBm.

(2) Connect ac voltmeter to J20. Meter should indicate -14.7 ±0.5 dBm.

(3) Disconnect test equipment and remove jumper connected between E26 and E27.

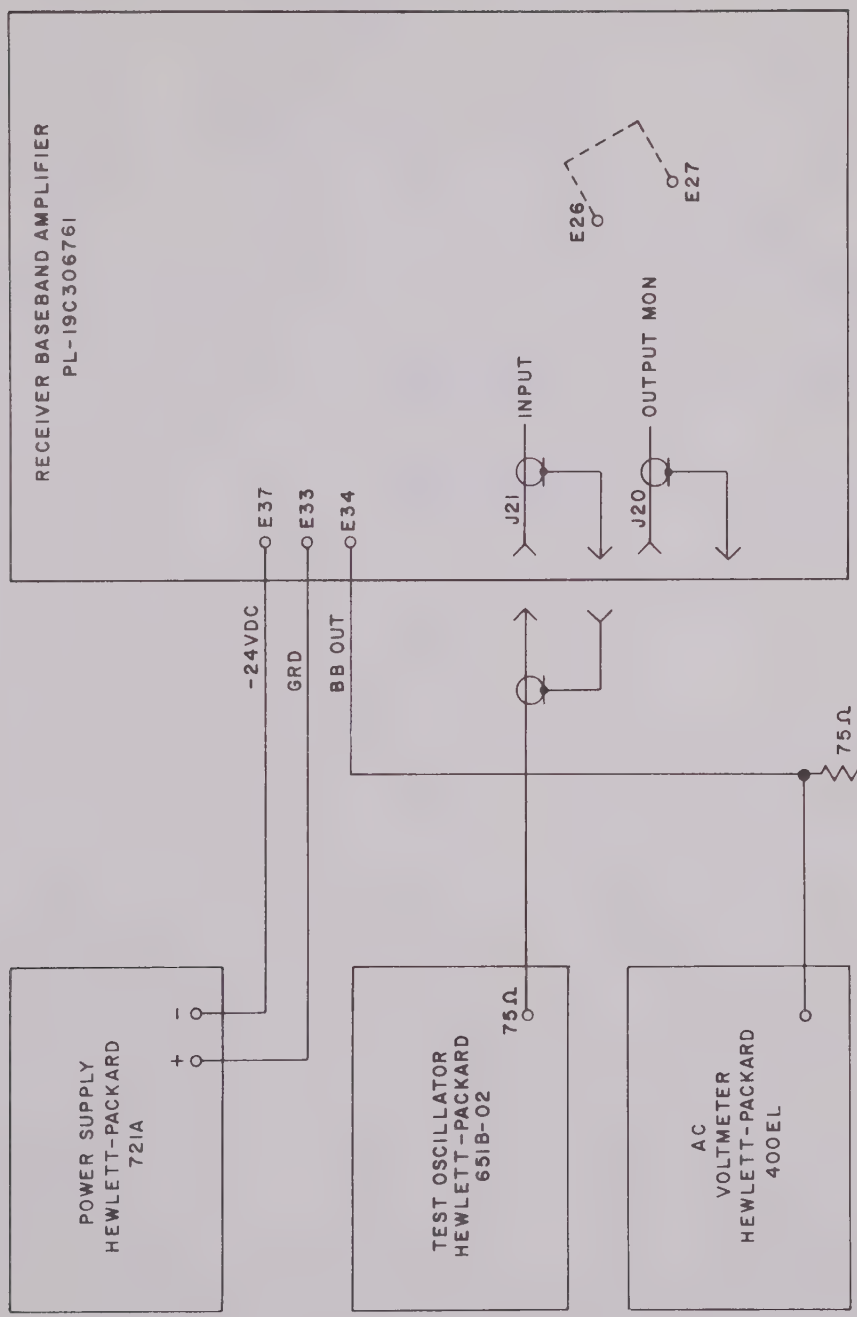

Figure 2. Receiver Baseband Amplifier, Test Setup Diagram

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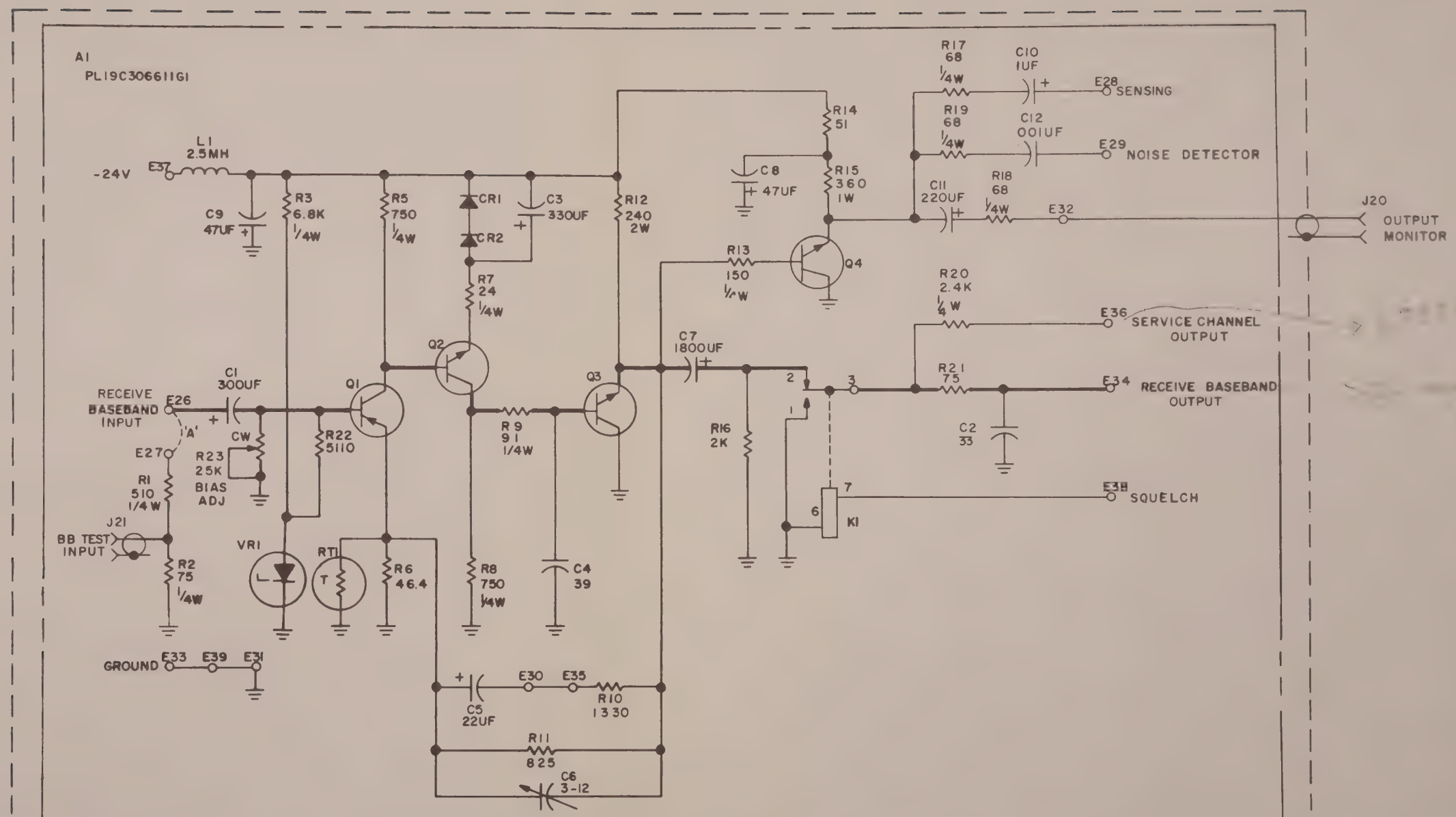

NOTES:

1- ALL RESISTORS ARE 1/2 WATT UNLESS OTHERWISE SPECIFIED AND RESISTOR VALUES IN OHMS UNLESS FOLLOWED BY K 1000 OHMS OR MEG 1,000,000 OHMS. CAPACITOR VALUES IN PICOFARADS (EQUAL TO MICROMICROFARADS) UNLESS FOLLOWED BY UF MICROFARADS. INDUCTANCE VALUES IN MICROHENRYS UNLESS FOLLOWED BY MH MILLIHENRYS OR H HENRYS.

2- ADD JUMPER 'A' FOR BASEBAND TEST ONLY.

SEMI-CONDUCTOR CHART

ITEM NO.	G.E. IDENT. NO.	SIMILAR TO * JEDEC REG. NO.
CR1 & CR2	19A115250P1	
Q1	19A115852 P1	2N3906
Q2	19A115591 P1	2N2218A
Q3	19A115944P2	2N2218A
Q4	19A115300P1	2N3053
VR1	A4036887P1	

*FOR REFERENCE ONLY NOT RECOMMENDED FOR DIRECT REPLACEMENT

Elementary Diagram

RECEIVER BASEBAND AMPLIFIER
PL-19C306761-G1, REV. A

(Drawing No. 19C306745, Rev. 2)

Service Outline

RECEIVER BASEBAND AMPLIFIER
PL-19C306761-G1 & G2

(Drawing No. 19B210875, Rev. 2)

RECEIVER BASEBAND AMPLIFIER
PL-19C306761-G1

PL-19C306761-G1, REV.A

Specifications for transistor Q3 were changed, resistor R4 was deleted, variable resistor R23 and Zener diode VR1 were added.

PARTS LIST CHANGES

Symbol	GE Part No.	Description
Change from:		
Q3	19A115591-P1	Silicon, NPN: Sim to Type 2N2218A
To:		
Q3	19A115944-P2	Silicon, NPN: Sim to Type 2N2218A
Delete:		
R4	3R152-P471J	Composition: 470 ohms ±5%, 1/4w.
Add:	19B209358-P107	Variable carbon film: approx 75 to 25000 ohms ±20%, 0.25 w. Sim to CTS Type X-201
VR1	4036887-P1	Silicon Zener

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PARTS LIST

RECEIVER BASEBAND AMPLIFIER
19C306761-G2, Rev. A

SYMBOL	G-E PART NO.	DESCRIPTION
		COMPONENT BOARD ASSEMBLY 19C306611-G1
		- - - - - - - - - - CAPACITORS - - - - - - - - -
C1	19A115680-P14	Electrolytic: 300 µf +150% -10%, 7 VDCW; sim to Mallory Type TT.
C2	5490008-P15	Silver mica: 33 pf ±5%, 500 VDCW; sim to Electro Motive Type DM-15.
C3	5496267-P4	Tantalum: 330 µf ±20%, 6 VDCW; sim to Sprague Type 150D.
C4	5490008-P17	Silver mica: 39 pf ±5%, 500 VDCW; sim to Electro Motive Type DM-15.
C5	5496267-P10	Tantalum: 22 µf ±20%, 15 VDCW; sim to Sprague Type 150D.
C6	5490446-P3	Variable, ceramic: approx 3-12 pf, 350 VDCW, temp coef 0 PPM; sim to Erie Style 557-36.
C7	19A123056-P3	Electrolytic: 1800 µf +75% -10%, 20 VDCW; sim to Sprague Type 34D.
C8 and C9	5496267-P20	Tantalum: 47 µf ±20%, 35 VDCW; sim to Sprague Type 150D.
C10	5496267-P17	Tantalum: 1.0 µf ±20%, 35 VDCW; sim to Sprague Type 150D.
C11	5496267-P8	Tantalum: 220 µf ±20%, 10 VDCW; sim to Sprague Type 150D.
C12	4029003-P8	Silver mica: 1000 pf ±5%, 500 VDCW; sim to Electro Motive Type DM-20.
		- - - - - - - DIODES AND RECTIFIERS - - - - - - -
CR1 and CR2	19A115250-P1	Silicon.
VR1*	4036887-P1	Silicon, Zener (added by Rev. A).
		- - - - - - - - - - TERMINALS - - - - - - - - - -
E26 thru E39	19A115296-P1	Terminal, stud.
		- - - - - - - JACKS AND RECEPTACLES - - - - - - -
J21	7776570-P17	Receptacle, bulkhead: coaxial, 500 v peak. Military Type UG-1094/U.
		- - - - - - - - - - - RELAYS - - - - - - - - - - -
K1	19B200576-P1	Reed, mercury wetted: 940 ohms ±10% coil res, 0.5 amps max contact load; sim to CP Clare HGSM-1002. (G1 only)
		- - - - - - - - - - INDUCTORS - - - - - - - - -
L1	7491382-P109	Coil, RF: 2500 µh ±10%, 35 ohms DC res max; sim to Delevan 3500 Series.
		- - - - - - - - - TRANSISTORS - - - - - - - - -
Q1	19A115852-P1	Silicon, PNP; sim to Type 2N3906.
Q2	19A115591-P1	Silicon, NPN; sim to Type 2N2218A.
Q3*	19A115944-P2	Silicon, NPN; sim to Type 2N2218A.
Q4	19A115300-P1	Silicon, NPN; sim to Type 2N3053.
		- - - - - - - - - - RESISTORS - - - - - - - - - -
R1	3R152-P511J	Composition: 510 ohms ±5%, 1/4 w.
R2	3R152-P750J	Composition: 75 ohms ±5%, 1/4 w.
R3	3R152-P682J	Composition: 6800 ohms ±5%, 1/4 w.
R4*	3R152-P471J	Composition: 470 ohms ±5%, 1/4 w. (In units prior to Rev. A).
R5	3R152-P751J	Composition: 750 ohms ±5%, 1/4 w.
R6	5495948-P65	Deposited carbon: 46.4 ohms ±1%, 1/2 w; sim to Texas Instrument CD1/2MR.
R7	3R152-P240J	Composition: 24 ohms ±5%, 1/4 w.
R8	3R152-P751J	Composition: 750 ohms ±5%, 1/4 w.
R9	3R152-P910J	Composition: 91 ohms ±5%, 1/4 w.
R10	5495948-P213	Deposited carbon: 1330 ohms ±1%, 1/2 w; sim to Texas Instrument CD1/2MR.
R11	5495948-P189	Deposited carbon: 825 ohms ±1%, 1/2 w; sim to Texas Instrument CD1/2MR.
R12	3R79-P241J	Composition: 240 ohms ±5%, 2 w.
R13	3R152-P151J	Composition: 150 ohms ±5%, 1/4 w.
R14	3R77-P510J	Composition: 51 ohms ±5%, 1/2 w.
R15	3R78-P361J	Composition: 360 ohms ±5%, 1 w.
R16	3R152-P202J	Composition: 2000 ohms ±5%, 1/4 w.
R17 thru R19	3R152-P680J	Composition: 68 ohms ±5%, 1/4 w.
R20	3R152-P242J	Composition: 2400 ohms ±5%, 1/4 w.
R21	5495948-P85	Deposited carbon: 75 ohms ±1%, 1/2 w; sim to Texas Instrument CD1/2MR.
R22	5495948-P269	Deposited carbon: 5110 ohms ±1%, 1/2 w; sim to Texas Instrument CD1/2MR.
R23*	19B207358-P107	Variable carbon film: approx. 75 to 25,000 ohms ±20%, 0.25 w. sim to CTS Type X-201. (added by Rev. A).
		- - - - - - - - - THERMISTORS - - - - - - - - - -
RT1	5490828-P18	Thermistor: 5000 ohms ±10%, color code white; sim to Globar Type 763H-24.
		- - - - - - - - - MISCELLANEOUS - - - - - - - - -
	19A115580-P1	Heat sink. (Used with Q3).
	4036555-P1	Insulator, washer. (Used with Q2, Q3 and Q4).
		- - - - - - - JACKS AND RECEPTACLES - - - - - - -
J20	7776570-P18	Receptacle, right angle: coaxial, 500 v peak. Military Type UF-1098/U.

*COMPONENTS ADDED, DELETED OR CHANGED BY PRODUCTION CHANGES.

SECTION II

PRINCIPLES OF OPERATION

NOISE DETECTOR
PL-19B208271-G1 & -G2

2.0 GENERAL

2.0.1 The noise detector detects thermal noise above the maximum baseband signal frequency. Its circuitry includes the adjustment used to set the squelch level of the receiver. Should noise exceed this level, the unit supplies a squelch voltage to the receiver baseband amplifier and to the receiver sensing unit. The detector is constructed on a printed wire board that is located inside a completely enclosed shielding chassis mounted on the inner receiver door assembly.

2.1 SPECIFICATIONS

Input Impedance:	75 ohms
Squelch Output:	-12 vdc (when loaded by the squelch relay)
Supply Voltage:	-24 vdc

2.2 CIRCUIT DESCRIPTION

2.2.1 The detector circuit is described with reference to Elementary Diagram 19C306737.

2.2.2 Input signal (from the baseband amplifier) is applied at terminal E1. The signal is applied to the base of amplifier stage Q1 through a low-pass and a high-pass filter. Low-pass filter L11-C24-C25 assures that any high frequency harmonics generated within the unit will be confined to the shielded enclosure. All components of the baseband signal below 9.5 MHz in the Group 1 unit or 4.2 MHz in the Group 2 unit are blocked by the high-pass filter consisting of capacitors G1 through C6 and inductors L1 through L5. The output of the high-pass filter is applied to the base of stage Q1.

2.2.3 Transistor Q1 is a wideband video amplifier whose response extends from about 1 MHz to 15 MHz. Its output drives squelch noise amplifier Q2. The signal applied to the base of Q2 is taken from SQUELCH ADJUST control R7. This control is adjusted to set the squelch level of the receiver. The output of Q2 is detected by voltage doubler rectifier C13-CR1-CR2. Detector output is applied to the input of a Schmitt trigger level detector.

2.2.4 Transistors Q3 and Q4 form a Schmitt trigger level detector that in turn controls switching transistor Q5. The circuit is set

up so Q3 is turned on and Q4 and transistor switch Q5 are turned off when noise level is such that the receiver is not squelched. As noise level increases, the output of the detector becomes more positive. When it becomes sufficiently positive to turn Q3 off, Q4 will be turned on. This in turn will cause Q5 to be turned on and current is supplied to the squelch circuits connected to output terminal C27-A. The receiver will remain in the squelched condition until noise level decreases to the point where detector output is such that Q3 can turn on. This point is reached when input noise level has dropped about 5 dB.

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MAINTENANCE

NOISE DETECTOR
PL-19B208271-G1, -G3

2.0 GENERAL

2.0.1 Bench maintenance procedures for the noise detector consist of an operational check to assure that a squelch voltage is provided when the thermal baseband noise exceeds a predetermined level above the maximum baseband signal (4.2 MHz and above for groups 2 and 3 and 8.5 MHz and above for group 1). R7 sets the predetermined threshold level. In addition, the group 3 unit provides a dc voltage proportional to the baseband noise level to operate the diversity combiners. The level of this voltage is controlled by R19.

2.0.2 A regulated -24 ±0.5 vdc power source is required to operate the noise detector.

2.0.3 Refer to elementary drawing 19C306737 for group 1 and group 2 units and to elementary drawing 19C306738 for group 3 units. For the service outline refer to drawing 19B210878. The service outline may be used for the location and identification of controls and components.

2.1 TEST EQUIPMENT REQUIRED (or equivalent)

2.1.1 The test equipment required for maintenance of the noise detector is listed in figure 1. The test setup diagram is illustrated in figure 2.

TEST EQUIPMENT	MODEL	REQUIREMENT
DC Voltmeter (Hewlett-Packard)	412A	
Power Supply (Hewlett-Packard)	721A	-24 vdc
Resistor, 680 ohm, 1 watt		
RF Voltmeter (Hewlett-Packard)	411A with "Test" probe 11024A	10 MHz
Test Oscillator (Hewlett-Packard)	651B-02	10 MHz

Figure 1. Test Equipment Required (or equivalent)

2.2 MAINTENANCE PROCEDURES

2.2.1 OPERATIONAL CHECK

(1) Connect test equipment as illustrated in figure 2.

(2) Set output voltage of power supply to -24 vdc.

(3) Adjust R7 and R19 (G3 unit only) full clockwise.

NOTE

Circuit board must be mounted in chassis during test.

(4) Set frequency of test oscillator to 10 MHz for group 1 units or to 5 MHz for group 2 and 3 units.

(5) Slowly increase output level of test oscillator until a voltage indication is obtained on dc voltmeter. The rf voltmeter should indicate 55 millivolts or less for G1 units and 40 millivolts or less for G2 and G3 units. Record this level. DC voltmeter should indicate -12 ± 0.5 vdc.

(6) Slowly decrease the output level of the test oscillator until the dc voltage at C27A just drops to zero (voltage must go to zero). RF voltmeter should indicate 6 ± 1 db below the voltage recorded in step (5).

(7) For group 1 units set output level of test oscillator to 55 millivolts. For group 2 and group 3 units set output level of test oscillator to 40 millivolts. Adjust R7 so that dc voltage at C27A is -12 vdc.

(8) (Group 3 unit only). Connect C29 to ground.

(9) (Group 3 unit only). Connect dc voltmeter from C28 to ground. Set frequency of test oscillator to 5 MHz and output level to 4.1 millivolts as indicated on rf voltmeter. Voltage indicated on dc voltmeter should be -3.3 vdc or greater. Vary R19 and assure that it controls this voltage level.

(10) Connect dc voltmeter from C27A to ground. Set frequency of test oscillator to 8.5 MHz for group 1 units or to 3.5 MHz for group 2 and 3 units. Increase output level of test oscillator to maximum. There should be no voltage drop across C27A.

(11) Disconnect test equipment.

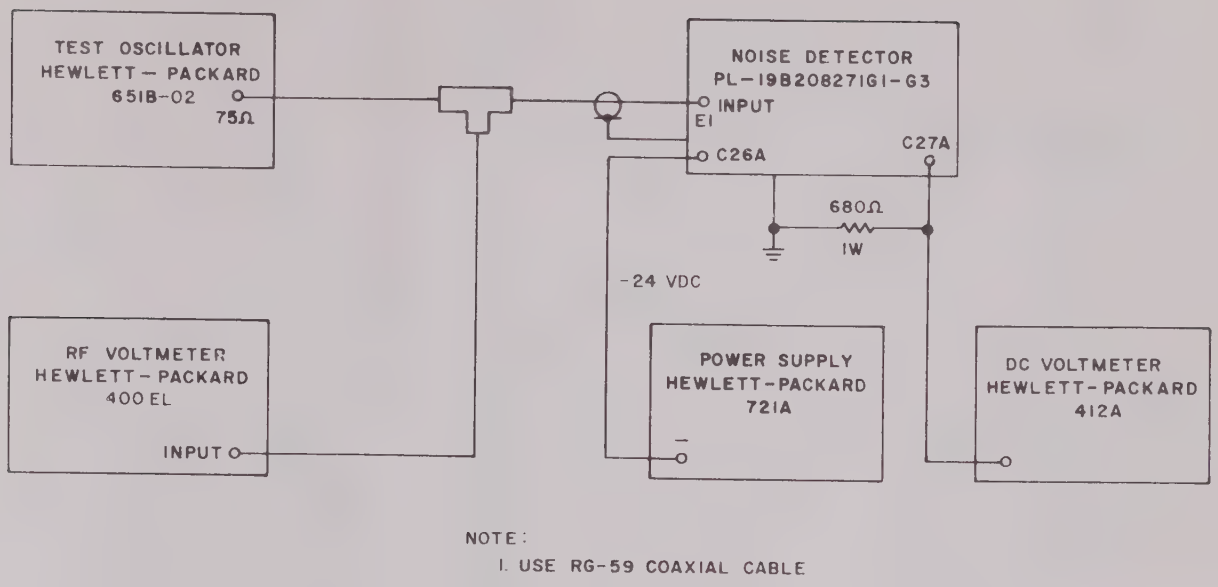

Figure 2. Noise Detector Bench Test Setup Diagram

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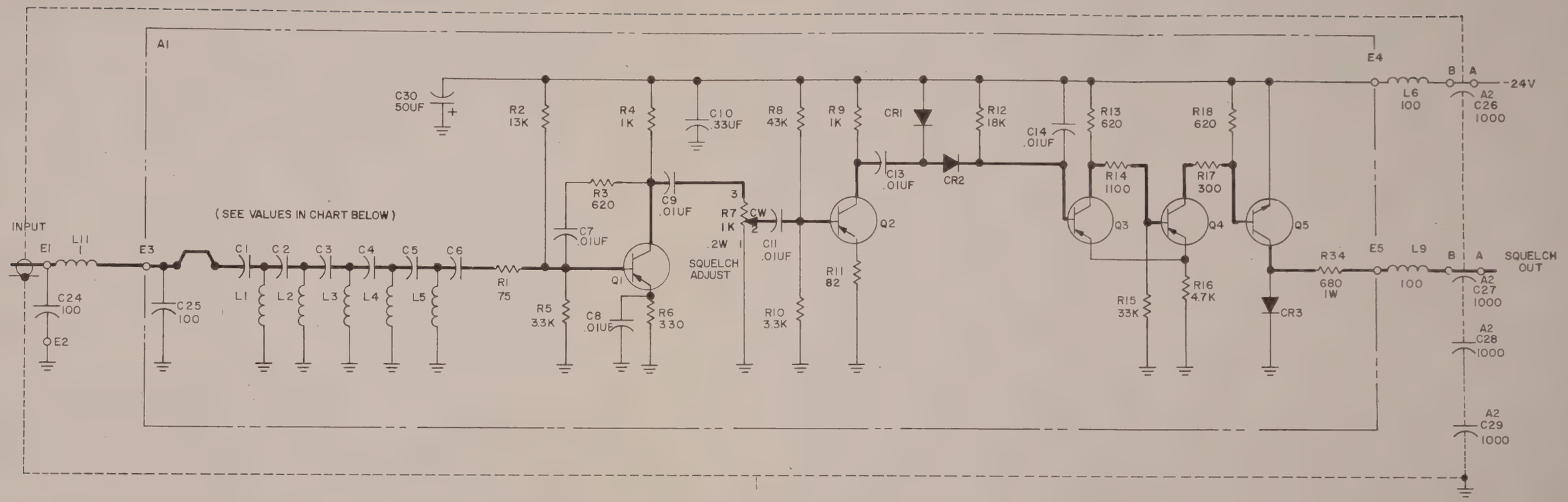


SEMI-CONDUCTOR CHART

ITEM NO.	G.E. IDENT NO	SIMILAR TO * JEDEC REG. NO
A1 CR1&2	A4038056P1	
A1 C R 3	19A115250P1	
A1 Q1&2	19A115852P1	2N3906
A1 Q3&4	19A115768P1	2N 3702
A1 Q 5	19A115300P1	2N 3053

* FOR REFERENCE ONLY NOT RECOMMENDED FOR DIRECT REPLACEMENT.

PL19B208271 GP IDENT.

GP NO	DESCRIPTION	A1	COMPONENT VALUES										
			A1C1	A1C2	A1C3	A1C4	A1C5	A1C6	A1L1	A1L2	A1L3	A1L4	A1L5
1	9.5 MC FILTER	19B208195 G1	160	100	92	92	100	160	.91	.82	.82	.82	.91
2	4.2 MC FILTER	19B208195 G2	390	220	220	220	220	390	2.0	1.8	1.8	1.8	2.0

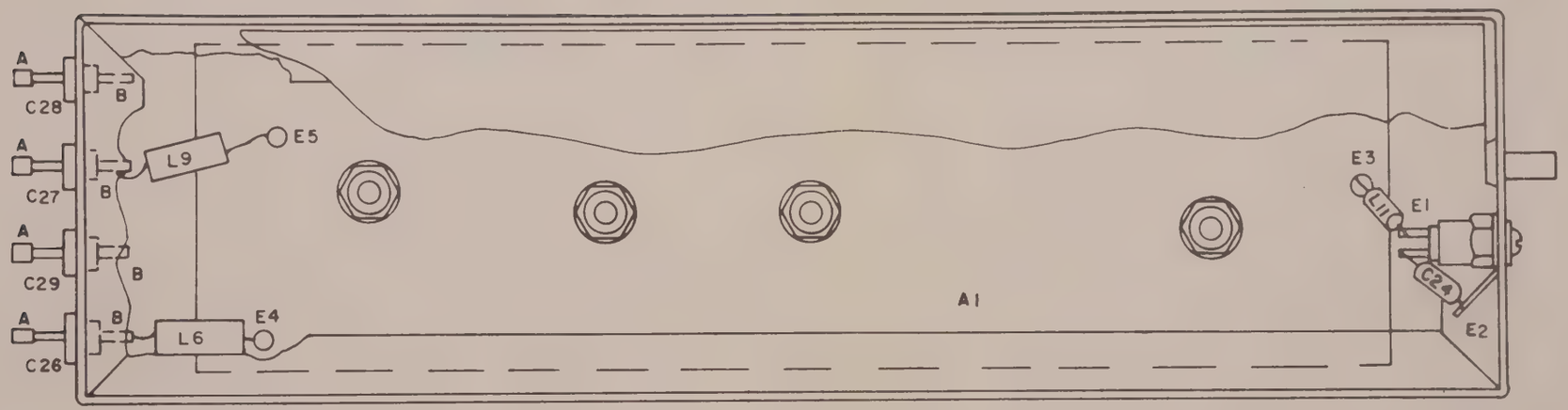
NOTES

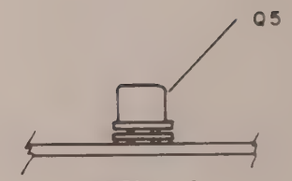
1. ALL RESISTORS ARE 1/2 WATT UNLESS OTHERWISE SPECIFIED AND RESISTOR VALUES IN OHMS UNLESS FOLLOWED BY K=1000 OHMS. OR MEG=1,000,000 OHMS. CAPACITOR VALUES IN PICOFARADS (EQUAL TO MICROMICROFARADS) UNLESS FOLLOWED BY UF= MICROFARADS. INDUCTANCE VALUES IN MICROHENRYS UNLESS FOLLOWED BY MH=MILLIHENRYS OR H=HENRYS.
2. A2 IS PL19B208271G10.
3. SUBASSEMBLY REFERENCE DESIGNATIONS ARE ABBREVIATED. PREFIX THE DESIGNATION WITH SUBASSEMBLY DESIGNATION

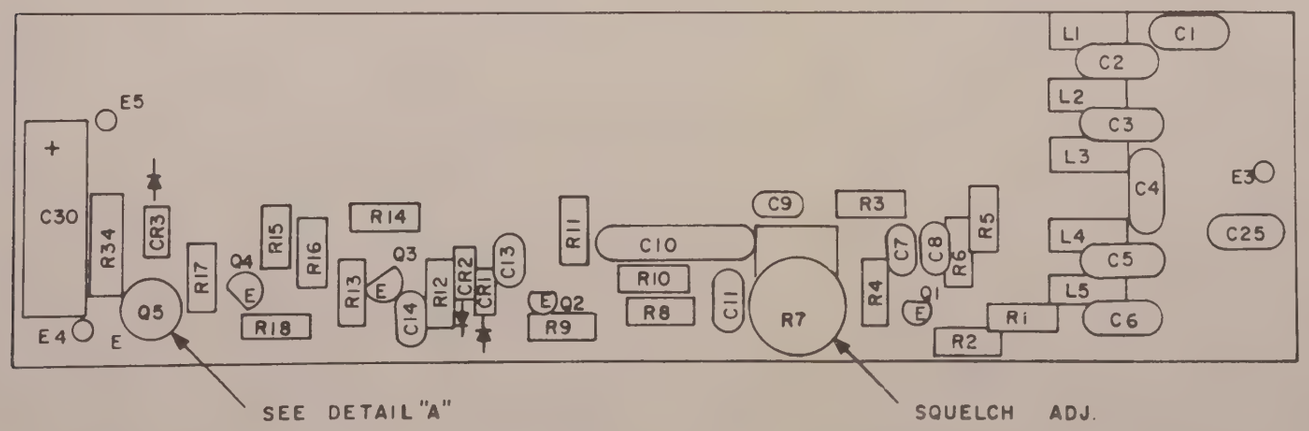
Elementary Diagram

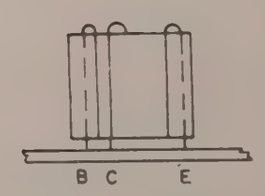
NOISE DETECTOR
PL-19B208271-G1 & G2

(Drawing No. 19C306737, Rev. 1)









TYP MTG FOR Q3 & Q4

Service Outline

NOISE DETECTOR
PL-19B208271-G1 & G2

(Drawing No. 19B210878, Sh. 1, Rev. 0)

PARTS LIST

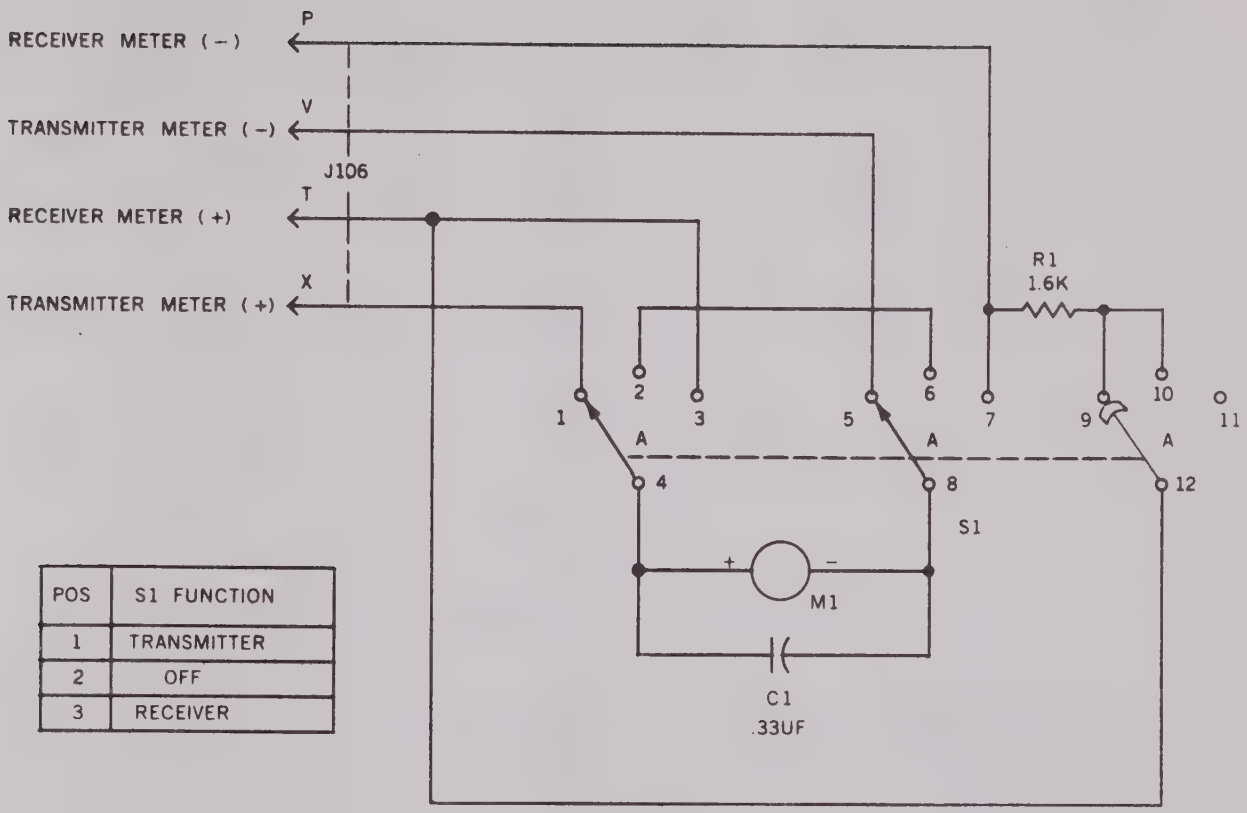
NOISE DETECTOR UNIT
19B208271-G1 thru G3

SYMBOL	G-E PART NO.	DESCRIPTION
A1		NOISE DETECTOR BOARD 19B208195-G1 (Used in 19B208271-G1) 19B208195-G2 (Used in 19B208271-G2) 19B208195-G3 (Used in 19B208271-G3)
		- - - - - - - - - - CAPACITORS - - - - - - - - - -
C1	5491870-P160G	Mica: 160 pf ±2%, 300 VDCW; sim to Electro Motive Type DM-15. (Used in G1 only).
C1	5491870-P390G	Mica: 390 pf ±2%, 300 VDCW; sim to Electro Motive Type DM-15. (Used in G2 and G3 only).
C2	5491870-P100G	Mica: 100 pf ±2%, 300 VDCW; sim to Electro Motive Type DM-15. (Used in G1 only).
C2	5491870-P220G	Mica: 220 pf ±2%, 300 VDCW; sim to Electro Motive Type DM-15. (Used in G2 and G3 only).
C3	5491870-P92G	Mica: 92 pf ±2%, 300 VDCW; sim to Electro Motive Type DM-15. (Used in G1 only).
C3	5491870-P220G	Mica: 220 pf ±2%, 300 VDCW; sim to Electro Motive Type DM-15. (Used in G2 and G3 only).
C4	5491870-P92G	Mica: 92 pf ±2%, 300 VDCW; sim to Electro Motive Type DM-15. (Used in G1 only).
C4	5491870-P220G	Mica: 220 pf ±2%, 300 VDCW; sim to Electro Motive Type DM-15. (Used in G2 and G3 only).
C5	5491870-P100G	Mica: 100 pf ±2%, 300 VDCW; sim to Electro Motive Type DM-15. (Used in G1 only).
C5	5491870-P220G	Mica: 220 pf ±2%, 300 VDCW; sim to Electro Motive Type DM-15. (Used in G2 and G3 only).
C6	5491870-P160G	Mica: 160 pf ±2%, 300 VDCW; sim to Electro Motive Type DM-15. (Used in G1 only).
C6	5491870-P390G	Mica: 390 pf ±2%, 300 VDCW; sim to Electro Motive Type DM-15. (Used in G2 and G3 only).
C7 thru C9	5491189-P1	Polyester: 0.01 µf ±20%, 50 VDCW.
C10	5491189-P9	Polyester: 0.33 µf ±20%, 50 VDCW.
C11	5491189-P1	Polyester: 0.01 µf ±20%, 50 VDCW.
C13 and C14	5491189-P1	Polyester: 0.01 µf ±20%, 50 VDCW.
C15 thru C17	5491189-P1	Polyester: 0.01 µf ±20%, 50 VDCW. (Used in G3 only)
C18	5491189-P6	Polyester: 0.1 µf ±20%, 50 VDCW. (Used in G3 only).
C19	5491189-P1	Polyester: 0.01 µf ±20%, 50 VDCW. (Used in G3 only).
C20	5491189-P8	Polyester: 0.22 µf ±20%, 50 VDCW. (Used in G3 only).
C21	5491189-P1	Polyester: 0.01 µf ±20%, 50 VDCW. (Used in G3 only).
C22 and C23	5491189-P9	Polyester: 0.33 µf ±20%, 50 VDCW. (Used in G3 only).
C25	5490008-P27	Silver mica: 100 pf ±5%, 500 VDCW; sim to Electro Motive Type DM-15.
C30	19A115680-P11	Electrolytic: 50 µf +150% -10%, 35 VDCW; sim to Mallory Type TT.
		- - - - - - - DIODES AND RECTIFIERS - - - - - - -
CR1 and CR2	4038056-P1	Germanium.
CR3	19A115250-P1	Silicon.
CR4 and CR5	4038056-P1	Germanium. (Used in G3 only).

SYMBOL	G-E PART NO	DESCRIPTION
		- - - - - - - - - - INDUCTORS - - - - - - - - - -
L1	19C307007-P6	Coil, RF: .91 µh ±5%, .247 ohms DC res max; sim to Jeffers 1411-20J. (Used in G1 only).
L1	19C307007-P8	Coil, RF: 2 µh ±5%, .85 ohms DC res max; sim to Jeffers 1411-28J. (Used in G2 and G3 only).
L2	19C307007-P5	Coil, RF: .82 µh ±5%, .20 ohms DC res max; sim to Jeffers 4411-7J. (Used in G1 only).
L2	19C307007-P7	Coil, RF: 1.8 µh ±5%, .74 ohms DC res max; sim to Jeffers 4411-11J. (Used in G2 and G3 only).
L3	19C307007-P5	Coil, RF: .82 µh ±5%, .20 ohms DC res max; sim to Jeffers 4411-7J. (Used in G1 only).
L3	19C307007-P7	Coil, RF: 1.8 µh ±5%, .74 ohms DC res max; sim to Jeffers 4411-11J. (Used in G2 and G3 only).
L4	19C307007-P5	Coil, RF: .82 µh ±5%, .20 ohms DC res max; sim to Jeffers 4411-7J. (Used in G1 only).
L4	19C307007-P7	Coil, RF: 1.8 µh ±5%, .74 ohms DC res max; sim to Jeffers 4411-11J. (Used in G2 and G3 only).
L5	19C307007-P6	Coil, RF: .91 µh ±5%, .24 ohms DC res max; sim to Jeffers 4411-20J. (Used in G1 only).
L5	19C307007-P8	Coil, RF: 2 µh ±5%, .85 ohms DC res max; sim to Jeffers 4411-28J. (Used in G2 and G3 only).
L7	7488079-P72	Choke, RF: 100 µh ±10%, 2.60 ohms DC res max; sim to Jeffers 4424-9. (Used in G3 only).
L8	7491382-P101	Coil, RF: 100 µh ±10%, 4 ohms DC res max; sim to Delevan Series 3500. (Used in G3 only).
		- - - - - - - - - - TRANSISTORS - - - - - - - - - -
Q1 and Q2	19A115852-P1	Silicon, PNP; sim to Type 2N3906.
Q3 and Q4	19A115768-P1	Silicon, PNP; sim to Type 2N3702.
Q5	19A115300-P1	Silicon, NPN; sim to Type 2N3053.
Q6	19A115852-P1	Silicon, PNP; sim to Type 2N3906. (Used in G3 only).
Q7	19C300114-P1	Silicon, NPN. (Used in G3 only).
		- - - - - - - - - - RESISTORS - - - - - - - - - -
R1	3R77-P750J	Composition: 75 ohms ±5%, 1/2 w.
R2	3R77-P133J	Composition: 13,000 ohms ±5%, 1/2 w.
R3	3R77-P621J	Composition: 620 ohms ±5%, 1/2 w.
R4	3R77-P102J	Composition: 1000 ohms ±5%, 1/2 w.
R5	3R77-P332J	Composition: 3300 ohms ±5%, 1/2 w.
R6	3R77-P331J	Composition: 330 ohms ±5%, 1/2 w.
R7	19B209358-P3	Variable, carbon film: approx 25 to 1000 ohms ±20%, 0.2 w; sim to CTS Type U-201.
R8	3R77-P433J	Composition: 43,000 ohms ±5%, 1/2 w.
R9	3R77-P102J	Composition: 1000 ohms ±5%, 1/2 w.
R10	3R77-P332J	Composition: 3300 ohms ±5%, 1/2 w.
R11	3R77-P820J	Composition: 82 ohms ±5%, 1/2 w.
R12	3R77-P183J	Composition: 18,000 ohms ±5%, 1/2 w.
R13	3R77-P621J	Composition: 620 ohms ±5%, 1/2 w.
R14	3R77-P112J	Composition: 1100 ohms ±5%, 1/2 w.
R15	3R77-P333J	Composition: 33,000 ohms ±5%, 1/2 w.
R16	3R77-P472J	Composition: 4700 ohms ±5%, 1/2 w.
R17	3R77-P301J	Composition: 300 ohms ±5%, 1/2 w.
R18	3R77-P621J	Composition: 620 ohms ±5%, 1/2 w.
R19	19B209358-P3	Variable, carbon film: approx 25 to 1000 ohms ±20%, 0.2 w; sim to CTS Type U-201. (Used in G3 only).
R20	3R77-P303J	Composition: 30,000 ohms ±5%, 1/2 w. (Used in G3 only).
R21	3R77-P512J	Composition: 5100 ohms ±5%, 1/2 w. (Used in G3 only).

*COMPONENTS ADDED, DELETED OR CHANGED BY PRODUCTION CHANGES

SYMBOL	G-E PART NO	DESCRIPTION
R22	3R77-P182J	Composition: 1800 ohms ±5%, 1/2 w. (Used in G3 only).
R23	3R77-P303J	Composition: 30,000 ohms ±5%, 1/2 w. (Used in G3 only).
R24	3R77-P183J	Composition: 18,000 ohms ±5%, 1/2 w. (Used in G3 only).
R25	3R77-P470J	Composition: 47 ohms ±5%, 1/2 w. (Used in G3 only).
R26	3R77-P511J	Composition: 510 ohms ±5%, 1/2 w. (Used in G3 only).
R27	3R77-P102J	Composition: 1000 ohms ±5%, 1/2 w. (Used in G3 only).
R30	5495948-P217	Deposited carbon: 1470 ohms ±1%, 1/2 w; sim to Texas Instrument CD1/2MR. (Used in G3 only).
R34	3R78-P681J	Composition: 680 ohms ±5%, 1 w.
		- - - - - - - - - - CAPACITORS - - - - - - - - - -
C24	7489162-P27	Silver mica: 100 pf ±5%, 500 VDCW; sim to Electro Motive Type DM-15.
		- - - - - - - - - - TERMINALS - - - - - - - - - -
E1	7143206-P1	Terminal, stud.
E2	4035200-P2	Terminal, solder.
		- - - - - - - - - - INDUCTORS - - - - - - - - - -
L6	7491382-P101	Coil, RF: 100 µh ±10%, 4 ohms DC res max; sim to Delevan Series 3500.
L9	7491382-P101	Coil, RF: 100 µh ±10%, 4 ohms DC res max; sim to Delevan Series 3500.
L10	7491382-P101	Coil, RF: 100 µh ±10%, 4 ohms DC res max; sim to Delevan Series 3500. (Used in G3 only).
L11	7488079-P6	Choke, RF: 1 µh ±10%, .30 ohms DC res max; sim to Jeffers 4411-8.
L12	7491382-P101	Coil, RF: 100 µh ±10%, 4 ohms DC res max; sim to Delevan Series 3500. (Used in G3 only).



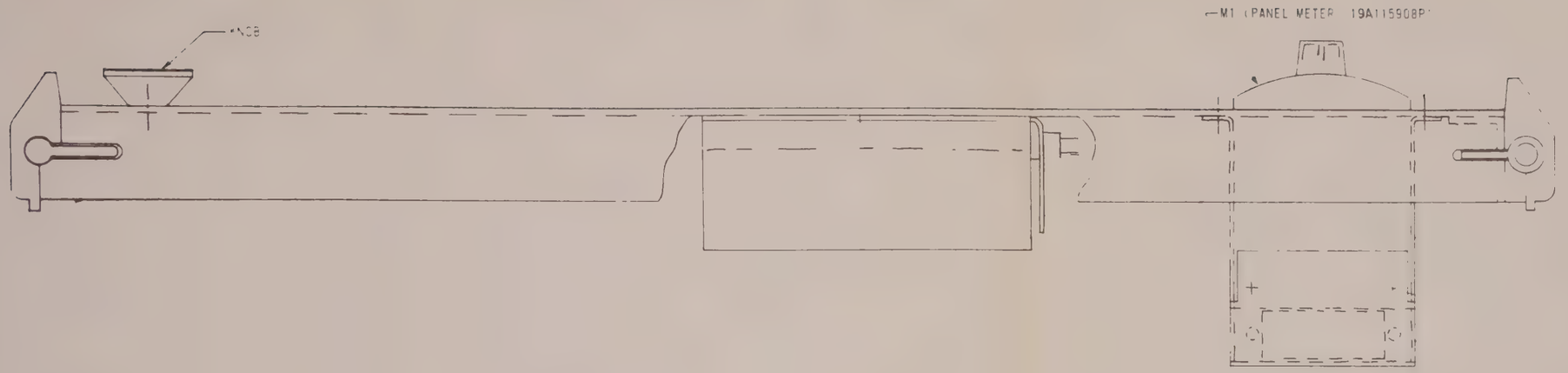
POS	S1 FUNCTION
1	TRANSMITTER
2	OFF
3	RECEIVER

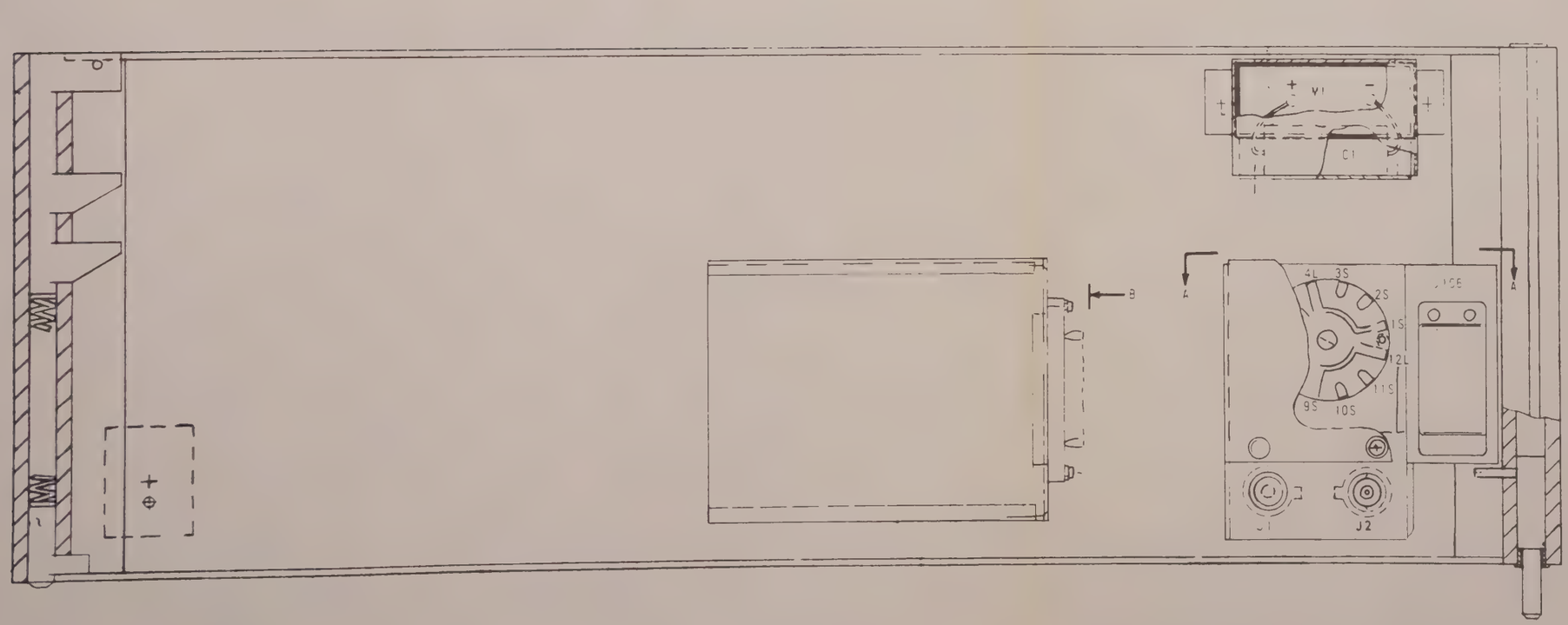
ALL RESISTORS ARE 1/2 WATT UNLESS OTHERWISE SPECIFIED AND RESISTOR VALUES IN OHMS UNLESS FOLLOWED BY K=1000 OHMS OR MEG = 1,000,000 OHMS. CAPACITOR VALUES IN PICOFARADS (EQUAL TO MICROMICROFARADS) UNLESS FOLLOWED BY UF = MICROFARADS. INDUCTANCE VALUES IN MICROHENRYS UNLESS FOLLOWED BY MH= MILLIHENRYS OR H=HENRYS

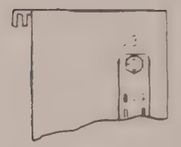
Elementary Diagram

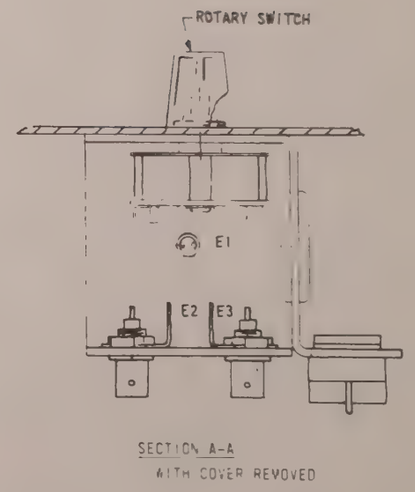
METER DOOR
PL-19D405530-G2

(Drawing No. 19C313651, Rev. 1)









SECTION A-A
WITH COVER REMOVED

Service Outline

METER DOOR
PL-19D405530-G1

(Drawing No. 19D409300, Rev. 0)

PARTS LIST

METER DOOR
19D405530-G1 THRU G3

SYMBOL	GE PART NO.	DESCRIPTION
		- - - - - - - - - CAPACITORS - - - - - - - - -
C1	7491930-P11	Polyester: .33 µf ±20%, 100 VDCW; sim to GE Type 61F.
		- - - - - - - - - - METERS - - - - - - - - - -
M1	19A115908-P1	Panel DC: 50 ma mechanism; sim to GE 50-185111-CYCY1JJF.
		- - - - - - - JACKS AND RECEPTACLES - - - - - -
J1 and J2	7776570-P17	Receptacle, bulkhead: coaxial, 500 v peak. Military Type UG-1094/U. (Used in G1 only).
J3	19B209014-P5	Connector, printed board: 10 contacts; sim to Precision Connectors 60-062-10-1027. (Used in G1 only).
J106	19B209227-P7	Plug: 38 contacts; sim to Elco 00-8016-038-000-013.
		- - - - - - - - - - RESISTORS - - - - - - - - -
R1	3R77-P162J	Composition: 1600 ohms ±5%, 1/2 w. (Used in G2 and G3 only).
R1	5495948-P257	Deposited carbon: 3830 ohms ±1%, 1/2 w; sim to Texas Instrument CD1/2MR. (Used in G1 only).
R2	3R77-P162J	Composition: 1600 ohms ±5%, 1/2 w. (Used in G1 and G3 only).
		- - - - - - - - - - SWITCHES - - - - - - - - - -
S1	19B209402-P4	Rotary: 1 section, 3 poles, 3 positions; sim to Oak Type JC. (Used in G1 and G2 only).
S1	19B209402-P3	Rotary: 2 sections, 4 poles, 6 positions; sim to Oak Type JC. (Used in G3 only).
		- - - - - - - - MISCELLANEOUS - - - - - - - - -
	4039182-G2	Knob: sim to Eastman Chemical 41659 (modified). (Used with S1).

*COMPONENTS ADDED, DELETED OR CHANGED BY PRODUCTION CHANGES

PRINCIPLES OF OPERATION

BASIC ALARM PANEL
PL-19C306900-G7

GENERAL

The basic alarm panel provides for:

a) fused -24 volt and -48 volt lines.

b) external connection facilities for auxiliary equipment in a TRS-696 basic radio rack.

c) the operation of one external receiver squelch alarm and one external radio fault alarm, when optional K1 and K2 relays are added.

The panel is mounted in the interconnect shelf at the top of a basic radio rack.

SPECIFICATIONS

Supply Voltages:	-24 Vdc -48 Vdc
Output Voltages:	four -24 volt lines fused at 1/2 amp each -48 volt line fused at 1 amp.
Fault contacts:	form "C" dry contacts, one set for receiver squelch alarm and one set for radio fault alarm.

CIRCUIT DESCRIPTION

The circuit is described with reference to Elementary Diagram 19B217247. Connections from the rack wiring harness are made at barrier strip terminal board TB103 at the rear of the panel. Customer connections are made at wire-wrap terminal boards TB101 and TB102 on front of panel.

The supply voltages are applied at TB103-1 and TB103-9. A fused -48 volt line is provided by the connection from the -48 volt input at TB103-1 through fuse F5 to TB102-D1 and D2. A -24 volt input from the power supply in the rack is connected to TB103-9. Four fused -24 volt lines are provided by applying the -24V through fuse F1 to terminal TB102-A2, through fuse F2 to terminal TB102-B2, through fuse F3 to terminal TB102-A1, through fuse F4 to terminal TB102-B1. Should any of these lines become shorted to ground, the surge current to blow a fuse (either F1, F2, F3 or F4) will be furnished by capacitor C1 through diode CR1.

The basic alarm circuit consists of optional relays K1 and K2. Relay K1 provides a receiver squelch alarm, relay K2 provides a radio fault alarm. Both relays will be energized by the voltage applied to them through resistors R1 and R2, respectively, when the radio equipment is operating normally. Terminal TB103-2 will be grounded if the receiver squelches, causing relay K1 to deenergize. Connections from the contacts on K1 to an external squelch alarm can be made at TB102-A8, A9 and A10. A receiver or a transmitter fault will cause TB103-4 or 6 to be grounded. Either of these will cause relay K2 to deenergize. Connections from the contacts on K2 to an external radio fault alarm can be made at TB102-B8, B9 and B10. The operation of this alarm indicates a radio fault, but it does not indicate whether it is the transmitter or the receiver which has faulted.

Connected at terminal TB102-A1 may be an Auxiliary Baseband Amplifier. If a fault occurs in this unit, terminal TB102-B5 will become grounded, deenergizing relay K2 and operating fault contacts B8, B9 and B10. A short circuit in the Auxiliary Amplifier will blow fuse F3, thus causing the -24 volts to relay K2 to now forward bias diode CR5 which will deenergize relay K2, operating fault contacts B8, B9 and B10.

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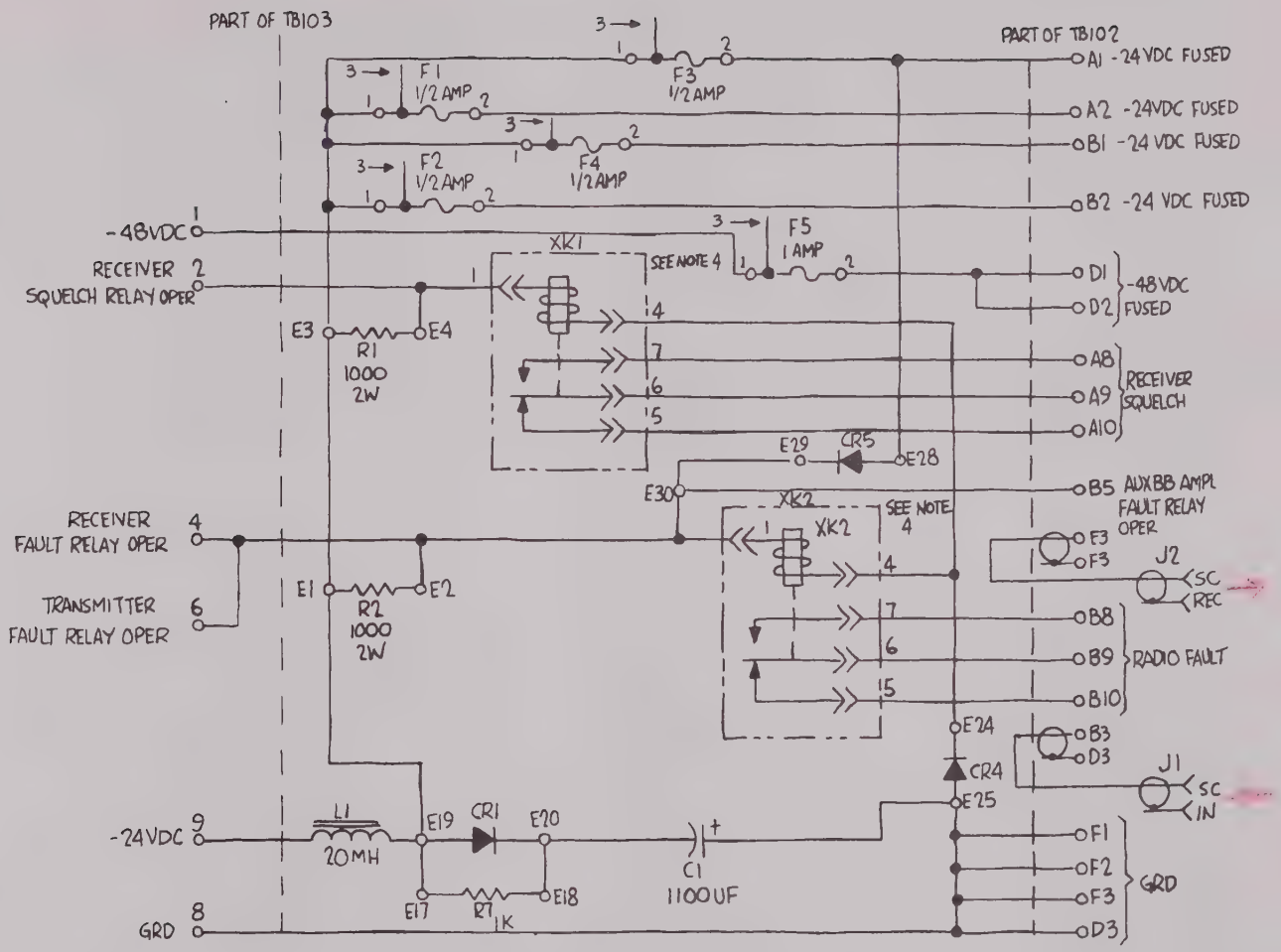
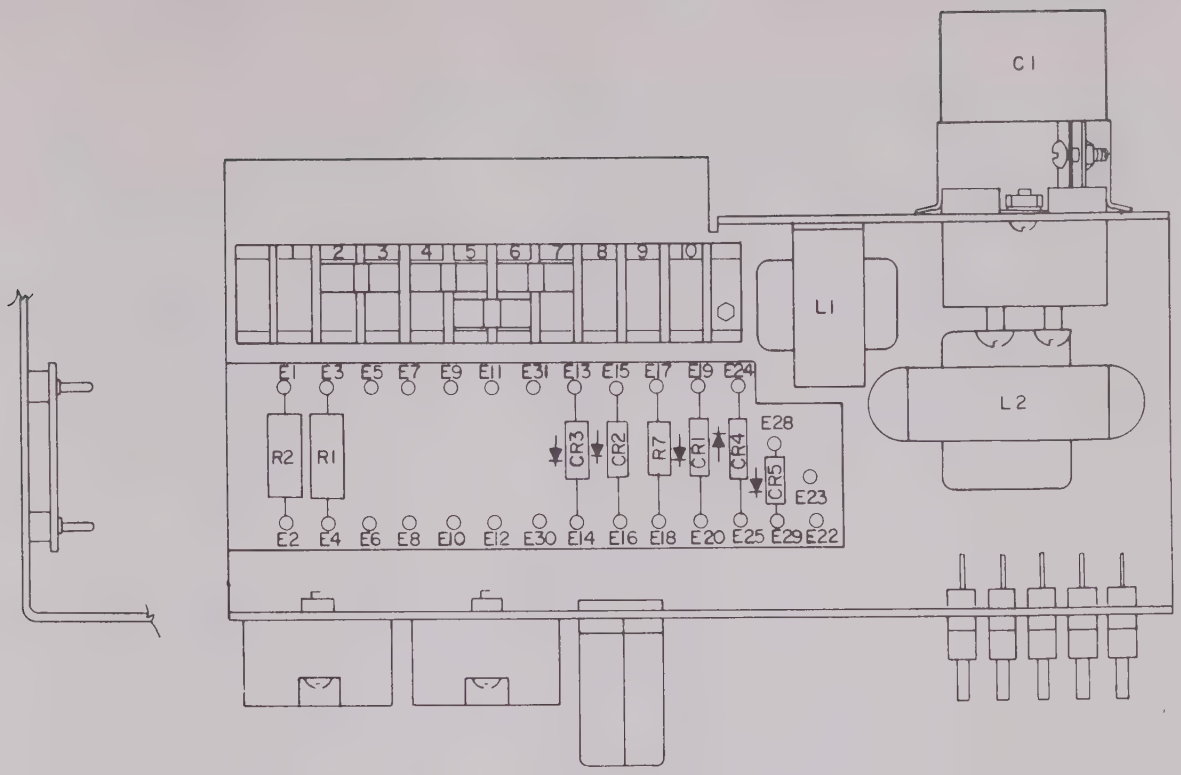


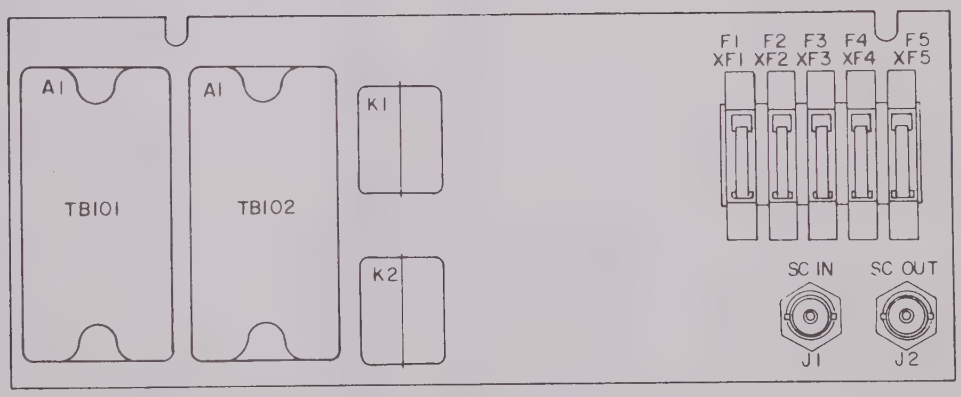
1. ALL RESISTORS ARE 1/2 WATT UNLESS OTHERWISE SPECIFIED AND RESISTOR VALUES IN OHMS UNLESS FOLLOWED BY K=1000 OHMS OR MEG = 1,000,000 OHMS. CAPACITOR VALUES IN PICOFARADS (EQUAL TO MICROMICROFARADS) UNLESS FOLLOWED BY UF = MICROFARADS. INDUCTANCE VALUES IN MICROHENRYS UNLESS FOLLOWED BY MH = MILLIHENRYS OR H = HENRYS.
2. ALL RELAYS ARE ENERGIZED DURING NORMAL OPERATION OF RADIO EQUIPMENT.
3. SEE FOLLOWING DWGS FOR OTHER CONNECTIONS TO TB102 RACK ELEM 19R640037.
4. K1 & K2 TO BE ADDED AS AN OPTION.

Elementary Diagram

BASIC ALARM PANEL
PL-19C306900-G7

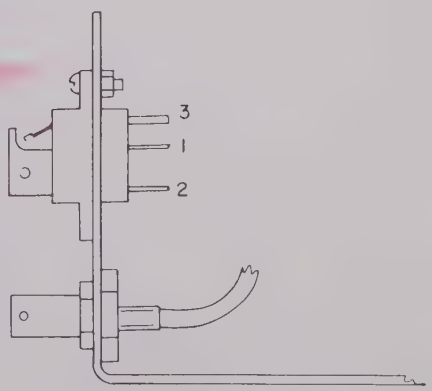
(Drawing No. 19B217247, Rev. 0)





NOTE:

1. RELAYS K1 & K2 ARE OMITTED ON G8 ASSEMBLY.
2. INDUCTOR L2 IS OMITTED ON G7 ASSEMBLY.
3. DIODES CR2 & CR3 ARE OMITTED ON G7 ASSEMBLY.



Service Outline

TWO-WAY ALARM PANEL
PL-19C306900-G6 & G8

(Drawing No. 19C319104, Rev. 1)

PARTS LIST

ALARM PANEL
19C306900-G5 thru G8

SYMBOL	G-E PART NO.	DESCRIPTION
		- - - - - - - - - - CAPACITORS - - - - - - - - - -
C1	5496520-P11	Electrolytic: 1100 µf +150% -10%, 35 VDCW; sim to GE Type 43F.
		- - - - - - - DIODES AND RECTIFIERS - - - - - - -
CR1	4037822-P1	Silicon.
CR2 and CR3	19A115823P1	Silicon. (Used in Groups 5,6 and 8 only).
CR4	4037822-P1	Silicon.
CR5	19B200250P1	Silicon.
		- - - - - - - - - - - FUSES - - - - - - - - - - -
F1 thru F4	19A115777P4	Open link: 1/2 amp at 300 v; sim to Bussmann GMT 1/2 Fuse.
F5	19A115777P9	Open link: 1 amp at 300 v; sim to Bussmann GMT 1 Fuse.
		- - - - - - - JACKS AND RECEPTACLES - - - - - - -
J1 and J2	19B209273-P1	Terminal, solderless: sim to AMP M5400-43-1.
		- - - - - - - - - - - RELAYS - - - - - - - - - - -
K1 and K2	19C307010-P21	Armature: 12VDC nominal, 1.5 w max operating, 1000 ohms ±15% coil res, 1 form C contact; sim to Allied Control T154-X-336. (Used in Groups 5 and 6 only)
K3 thru K7	19C307010-P1	Armature: 12VDC nominal, 1.5 w max operating, 1000 ohms ±15% coil res, 1 form C contact; sim to Allied Control T154-X-336. (Used in Group 5 only).
		- - - - - - - - - - INDUCTORS - - - - - - - - - -
L1	19B209345P1	Reactor:0.5 ohms DC res max, 15 VDC operating.
L2	19B209345P1	Reactor: 0.5 ohms DC res max, 15 VDC operating. (Used in Groups 5,6 and 8 only).
		- - - - - - - - - - RESISTORS - - - - - - - - - -
R1 and R2	3R79-P102J	Composition: 1000 ohms ±5%, 2 w.
R3 thru R6	3R79-P102J	Composition: 1000 ohms ±5%, 2 w. (Used in Group 5 only).
R7	3R79-P102J	Composition: 1000 ohms ±5%, 2 w.
R8	3R79-P102J	Composition: 1000 ohms ±5%, 2 w. (Used in Group 5 only).
		- - - - - - - - TERMINAL BOARDS - - - - - - - - -
TB101 and TB102	19A115842-P1	60 terminals; sim to AMP 582421.
TB103	19C301087-P5	Phen: 10 terminals; sim to GE CR151D.

SYMBOL	G-E PART NO	DESCRIPTION
		- - - - - - - - - - SOCKETS - - - - - - - - - -
XF1 thru XF5	19A115777P1	Fuseholder: sim to Bussman HLT Fuseholder.
XK1 and XK2	5491595-P4	Relay: 10 contacts; sim to Allied Control 30054-1.
XK3 thru XK7	5491595-P4	Relay: 10 contacts; sim to Allied Control 30054-1. (Used in Group 5 only).
		- - - - - - - - - MISCELLANEOUS - - - - - - - - -
	7150186-P105	Spacer: (Located between chassis and eyelet board).
	5491595-P8	Retainer: spring; sim to Allied Control 30040-1. (Used with K1-K7).
	7479571-P4	Retainer, capacitor. (Used with C1).

*COMPONENTS ADDED, DELETED OR CHANGED BY PRODUCTION CHANGES.

BASEBAND PAD
PL-19B208404-G25 and -G26

4.0 GENERAL

4.0.1 The baseband pad is an enclosed can assembly utilizing BNC connectors for the input and output. Jumper connections are provided to permit level adjustments of the TRS-696 radio or interfacing equipment in increments of 1/2 dB. The assembly mounts on the TRS-696 interconnect shelf.

4.1 SPECIFICATIONS

Input impedance:

G25	75 ohms
G26	600 ohms

Output impedance:

G25	75 ohms
G26	600 ohms

Attenuation range: from 0 dB to 31.5 dB in 1/2 dB increments.

4.2 DESCRIPTION

4.2.1 The baseband pad is a symmetrical π arrangement of 6 pads. Any one of these pads may be strapped in for any desired combination requiring from 0 to 31.5 dB attenuation in 1/2 dB increments.

4.2.2 Refer to Elementary Diagram 19A102710. For desired attenuation, refer to Elementary Diagram 19B217298 for jumper connections for baseband pad (19B208404-G25) and refer to Elementary Diagram 19B217402 for jumper connections for baseband pad (19B208404-G26).

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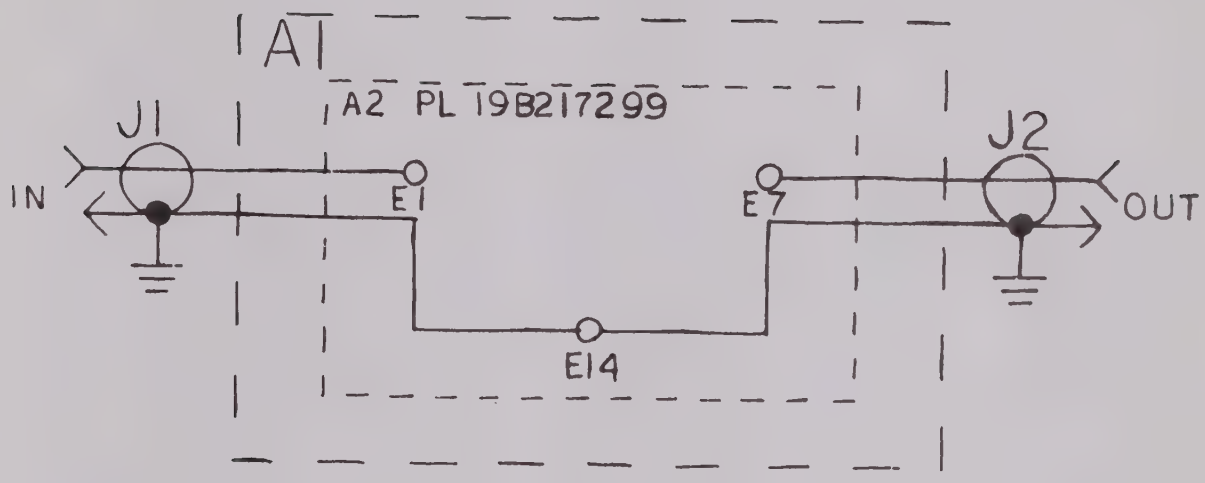
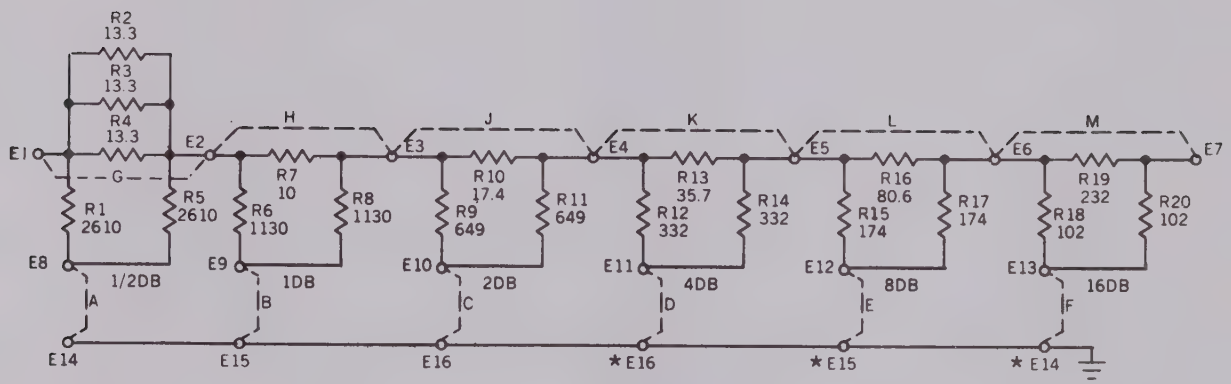


Elementary Diagram

BASEBAND PAD
PL-19B208404-G25 & G26
PL-19B220570-G3

(Drawing No. 19A102710, Rev. 0)



* DUPLICATED TERMINAL

NOTE:

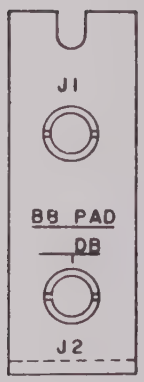
1. 0DB LOSS ADD JUMPERS G,H,J,K,L,M
   1/2DB LOSS ADD JUMPERS A,H,J,K,L,M
   1DB LOSS ADD JUMPERS B,G,J,K,L,M
   2DB LOSS ADD JUMPERS C,G,H,K,L,M
   4DB LOSS ADD JUMPERS D,G,H,J,L,M
   8DB LOSS ADD JUMPERS E,G,H,J,K,M
   16DB LOSS ADD JUMPERS F,G,H,J,K,L

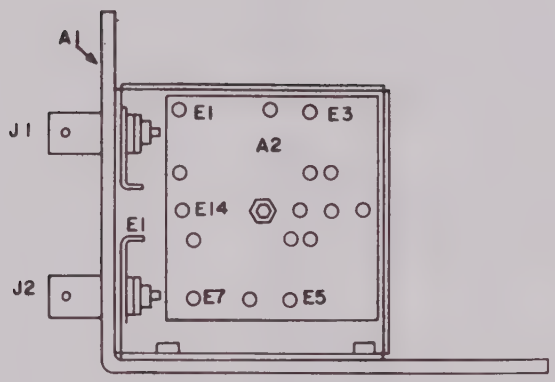
ALL RESISTORS ARE ½ WATT UNLESS OTHERWISE SPECIFIED AND RESISTOR VALUES IN OHMS UNLESS FOLLOWED BY K=1000 OHMS OR MEG=1,000,000 OHMS. CAPACITOR VALUES IN PICOFARADS (EQUAL TO MICROMICROFARADS) UNLESS FOLLOWED BY UF=MICROFARADS. INDUCTANCE VALUES IN MICROHENRYS UNLESS FOLLOWED BY MH=MILLIHENRYS OR H=HENRYS.

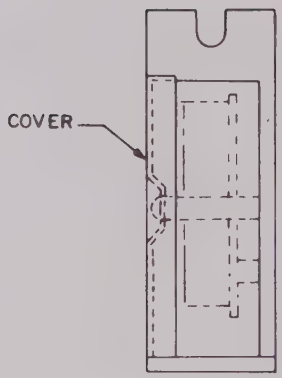
Elementary Diagram

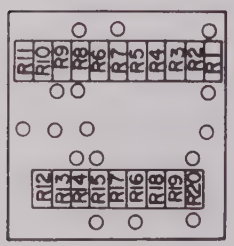
ATTENUATOR BOARD
PL-19B217299-G1

(Drawing No. 19B217298, Rev. 3)

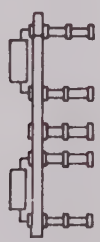


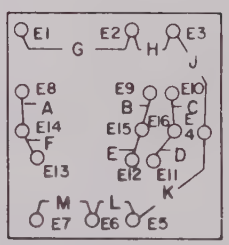






BOARD AS VIEWED
FROM DIP SOLDER SIDE





BOARD AS VIEWED
FROM COMPONENT SIDE

Service Outline

BASEBAND PAD
PL-19B208404-G25 & G26

(Drawing No. 19B211295, Rev. 0)

PARTS LIST

BASEBAND PAD
19B208404-G25 and G26

SYMBOL	G-E PART NO.	DESCRIPTION
A2		COMPONENT BOARD 19B217299-G1 (Used with 19B208404-G25)
		- - - - - - - - - - RESISTORS - - - - - - - - - -
R1	19B209294-P241	Metal film: 2610 ohms ±1%, 1/8 w; sim to IRC Type CEA-TO.
R2 thru R4	19B209294-P13	Metal film: 13.3 ohms ±1%, 1/8 w; sim to IRC Type CEA-TO.
R5	19B209294-P241	Metal film: 2610 ohms ±1%, 1/8 w; sim to IRC Type CEA-TO.
R6	19B209294-P206	Metal film: 1130 ohms ±1%, 1/8 w; sim to IRC Type CEA-TO.
R7	19B209294-P1	Metal film: 10.0 ohms ±1%, 1/8 w; sim to IRC Type CEA-TO.
R8	19B209294-P206	Metal film: 1130 ohms ±1%, 1/8 w; sim to IRC Type CEA-TO.
R9	19B209294-P179	Metal film: 649 ohms ±1%, 1/8 w; sim to IRC Type CEA-TO.
R10	19B209294-P24	Metal film: 17.4 ohms ±1%, 1/8 w; sim to IRC Type CEA-TO.
R11	19B209294-P179	Metal film: 649 ohms ±1%, 1/8 w; sim to IRC Type CEA-TO.
R12	19B209294-P151	Metal film: 332 ohms ±1%, 1/8 w; sim to IRC Type CEA-TO.
R13	19B209294-P54	Metal film: 35.7 ohms ±1%, 1/8 w; sim to IRC Type CEA-TO.
R14	19B209294-P151	Metal film: 332 ohms ±1%, 1/8 w; sim to IRC Type CEA-TO.
R15	19B209294-P124	Metal film: 174 ohms ±1%, 1/8 w; sim to IRC Type CEA-TO.
R16	19B209294-P88	Metal film: 80.6 ohms ±1%, 1/8 w; sim to IRC Type CEA-TO.
R17	19B209294-P124	Metal film: 174 ohms ±1%, 1/8 w; sim to IRC Type CEA-TO.
R18	19B209294-P102	Metal film: 102 ohms ±1%, 1/8 w; sim to IRC Type CEA-TO.
R19	19B209294-P136	Metal film: 232 ohms ±1%, 1/8 w; sim to IRC Type CEA-TO.
R20	19B209294-P102	Metal film: 102 ohms ±1%, 1/8 w; sim to IRC Type CEA-TO.
A2		COMPONENT BOARD 19B217299-G2 (Used with 19B208404-G26)
		- - - - - - - - - - RESISTORS - - - - - - - - - -
R1	19B209294-P332	Metal film: 21,000 ohms ±1%, 1/8 w; sim to IRC Type CEA-TO.
R4	19B209294-P53	Metal film: 34.8 ohms ±1%, 1/8 w; sim to IRC Type CEA-TO.
R5	19B209294-P332	Metal film: 21,000 ohms ±1%, 1/8 w; sim to IRC Type CEA-TO.
R6	19B209294-P303	Metal film: 10,500 ohms ±1%, 1/8 w; sim to IRC Type CEA-TO.
R7	19B209294-P82	Metal film: 69.8 ohms ±1%, 1/8 w; sim to IRC Type CEA-TO.
R8	19B209294-P303	Metal film: 10,500 ohms ±1%, 1/8 w; sim to IRC Type CEA-TO.
R9	19B209294-P270	Metal film: 5230 ohms ±1%, 1/8 w; sim to IRC Type CEA-TO.
R10	19B209294-P115	Metal film: 140 ohms ±1%, 1/8 w; sim to IRC type CEA-TO.
R11	19B209294-P270	Metal film: 5230 ohms ±1%, 1/8 w; sim to IRC Type CEA-TO.
R12	19B209294-P242	Metal film: 2670 ohms ±1%, 1/8 w; sim to IRC Type CEA-TO.
R13	19B209294-P145	Metal film: 287 ohms ±1%, 1/8 w; sim to IRC Type CEA-TO.
R14	19B209294-P242	Metal film: 2670 ohms ±1%, 1/8 w; sim to IRC Type CEA-TO.
R15	19B209294-P215	Metal film: 1400 ohms ±1%, 1/8 w; sim to IRC Type CEA-TO.
R16	19B209294-P178	Metal film: 634 ohms ±1%, 1/8 w; sim to IRC Type CEA-TO.
R17	19B209294-P215	Metal film: 1400 ohms ±1%, 1/8 w; sim to IRC Type CEA-TO.
R18	19B209294-P189	Metal film: 825 ohms ±1%, 1/8 w; sim to IRC Type CEA-TO.
R19	19B209294-P226	Metal film: 1820 ohms ±1%, 1/8 w; sim to IRC Type CEA-TO.
R20	19B209294-P189	Metal film: 825 ohms ±1%, 1/8 w; sim to IRC Type CEA-TO.
		CAN 19A102059-G3
		- - - - - - - - JACKS AND RECEPTACLES - - - - - - - -
J1 and J2	7776570-P17	Receptacle, bulkhead: coaxial, 500 v peak. Military Type UG-1094/U.

*COMPONENTS ADDED, DELETED OR CHANGED BY PRODUCTION CHANGES.

PRINCIPLES OF OPERATION

AUXILIARY BASEBAND AMPLIFIER PL-19C313416-G2, G4

4.0 GENERAL

4.0.1 The auxiliary baseband amplifier is used to amplify the baseband signal to compensate for losses incurred in interconnection circuits between TRS-696 racks at repeater stations. The baseband amplifier is comprised of a three-stage transistor circuit.

4.0.2 The amplifier is constructed on printed circuit board located inside a metal container and mounted on the interconnect shelf of the radio rack. All connectors, a test point and a level adjustment control are accessible from the front panel.

4.1 SPECIFICATIONS

Gain:	0 to 15.7 ±0.2 dB	
Frequency Response: (300 kHz reference)	0 to -0.5 dB (300 Hz to 8.5 MHz)	
Impedance:	Group 2	Group 4
Input	75 ohms	600 ohms
Output	75 ohms	75 ohms
Supply Voltage:	-24 vdc	75 ma

4.2 CIRCUIT DESCRIPTION

4.2.1 The amplifier is described with reference to elementary diagrams 19C313401 (group 2) or 19C316930 for group 4.

4.2.2 The input signal connected to jack J1 appears across resistors R1 and R2. (The value and configuration of these resistors determine the input impedance.) The signal is then applied, at a level determined by the setting of LEVEL ADJ control R2, to amplifier A1. Amplifier A1 is a three-stage direct-coupled circuit. The input signal is applied to the base of A1Q1 through pin A1-6, A1R1 and A1CR1. Variable resistor A1R2, resistors A1R15, A1R1 and diode A1CR1 form the bias circuit for all three stages. A1R2 is adjusted so the voltage at the emitter of A1Q3 is -11 vdc.

4.2.3 The first two stages are complimentary common emitter stages formed by PNP transistor A1Q1 and NPN transistor A1Q2. They drive common collector power stage A1Q3. Negative feedback from the emitter of A1Q3 to the emitter of A1Q1 is used to achieve stability, increase bandwidth, and to set the overall gain of the amplifier. The feedback network consists of A1R6, A1C1 and A1R4. Variable capacitor A1C1 is used to adjust the frequency response of the amplifier. This

adjustment has its greatest effect from 4 MHz to 8.5 MHz. The amplifier output circuit consists of capacitors A1C2, A1C3, A1C4, A1C5 and A1R12. The capacitors are connected in parallel to form an output coupling capacitor. The output signal is taken from J2 through A1 pin 3.

4.2.4 Should the output coupling capacitor short, a disabling circuit consisting of A1CR2, A1R16, and A1C7 will turn off transistors Q1, Q2, and Q3. When the coupling capacitor shorts, CR2 is forward biased and conducts to increase the bias voltage at the base of A1Q1, turning it and the amplifier off.

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MAINTENANCE

AUXILIARY BASEBAND AMPLIFIER PL-19C313416-G1, -G5

GENERAL

Bench maintenance procedures for the auxiliary baseband amplifier (G1-G5) consist of: (1) adjusting the amplifier bias, (2) checking the frequency response and gain, and (3) operating the fault sensing circuits.

The frequency response is checked over the range of 300 Hz to 8.5 MHz for G1 & G2; 300 Hz to 500 kHz for G3, G4 & G5. The response should not vary from reference more than +.05 dB from 300 Hz to 4.5 MHz and +.2 dB from 300 Hz to 8.5 MHz. A1C1 and A2C1 may be adjusted to meet this requirement. In those groups having redundant amplifiers and fault sensing circuits the maintenance procedures are performed separately for the redundant unit. The fault sensing circuits are checked to assure proper switching to the standby unit when a fault is declared and that the sensing output at A5E6 is shorted to ground through A3Q5 or A4Q5. Operation of the fault alarm lamps are checked on groups 1, 3, and 5.

Basically, the auxiliary baseband amplifiers fall into two categories: units without fault sensing and units with fault sensing. Groups within each of these categories differ in that their specific input and output impedances are different. When setting up the units in a bench test configuration particular attention must be given to these impedance differences so that the correct input connections and output terminations are made. The specific input and output impedances for each group are given in figure 1.

IMPEDANCE	GROUP				
	1	2 *	3	4*	5
Input	75	75	600	600	75
Output	75	75	75	75	600
*Basic groups without fault sensing.					

Figure 1. Group Input/Output Impedance Table

Regulated -24 Vdc at 200 mA is required to operate the auxiliary baseband amplifier.

A separate elementary diagram is provided for each of the six groups. Service outline diagrams are provided as an aid to locate and identify components, jacks, and test points. The specific elementary diagram and service outline associated with each group is listed in figure 2.

adjustment has its greatest effect from 4 MHz to 8.5 MHz. The amplifier output circuit consists of capacitors A1C2, A1C3, A1C4, A1C5 and A1R12. The capacitors are connected in parallel to form an output coupling capacitor. The output signal is taken from J2 through A1 pin 3.

4.2.4 Should the output coupling capacitor short, a disabling circuit consisting of A1CR2, A1R16, and A1C7 will turn off transistors Q1, Q2, and Q3. When the coupling capacitor shorts, CR2 is forward biased and conducts to increase the bias voltage at the base of A1Q1, turning it and the amplifier off.

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MAINTENANCE

AUXILIARY BASEBAND AMPLIFIER PL-19C313416-G1, -G5

GENERAL

Bench maintenance procedures for the auxiliary baseband amplifier (G1-G5) consist of: (1) adjusting the amplifier bias, (2) checking the frequency response and gain, and (3) operating the fault sensing circuits.

The frequency response is checked over the range of 300 Hz to 8.5 MHz for G1 & G2; 300 Hz to 500 kHz for G3, G4 & G5. The response should not vary from reference more than +.05 dB from 300 Hz to 4.5 MHz and +.2 dB from 300 Hz to 8.5 MHz. A1C1 and A2C1 may be adjusted to meet this requirement. In those groups having redundant amplifiers and fault sensing circuits the maintenance procedures are performed separately for the redundant unit. The fault sensing circuits are checked to assure proper switching to the standby unit when a fault is declared and that the sensing output at A5E6 is shorted to ground through A3Q5 or A4Q5. Operation of the fault alarm lamps are checked on groups 1, 3, and 5.

Basically, the auxiliary baseband amplifiers fall into two categories: units without fault sensing and units with fault sensing. Groups within each of these categories differ in that their specific input and output impedances are different. When setting up the units in a bench test configuration particular attention must be given to these impedance differences so that the correct input connections and output terminations are made. The specific input and output impedances for each group are given in figure 1.

IMPEDANCE	GROUP				
	1	2 *	3	4*	5
Input	75	75	600	600	75
Output	75	75	75	75	600
*Basic groups without fault sensing.					

Figure 1. Group Input/Output Impedance Table

Regulated -24 Vdc at 200 mA is required to operate the auxiliary baseband amplifier.

A separate elementary diagram is provided for each of the six groups. Service outline diagrams are provided as an aid to locate and identify components, jacks, and test points. The specific elementary diagram and service outline associated with each group is listed in figure 2.

GROUP	ELEMENTARY DIAGRAM	SERVICE OUTLINE
1	19D405800	19C315739
2	19C313401	19C315738
3	19D409015	19C315739
4	19C316930	19C315738
5	19D409035	19C315739

Figure 2. Group/Diagram Identification

TEST EQUIPMENT REQUIRED (or equivalent)

Test equipment required for maintenance of the auxiliary baseband amplifier is listed in figure 3. The test setup diagram is illustrated in figure 4.

TEST EQUIPMENT	MODEL	REQUIREMENT
Ac Voltmeter (Hewlett-Packard)	400EL	
Dc Voltmeter (Hewlett-Packard)	427A	
Power Supply (Hewlett-Packard)	721A	-24 Vdc at 200 mA
Resistor Termination		75-ohm (G1-G4),600-ohm (G5)
Test Oscillator (Hewlett-Packard)	651B-02	300 Hz to 8.5 MHz

Figure 3. Test Equipment Required (Or Equivalent)

MAINTENANCE PROCEDURES

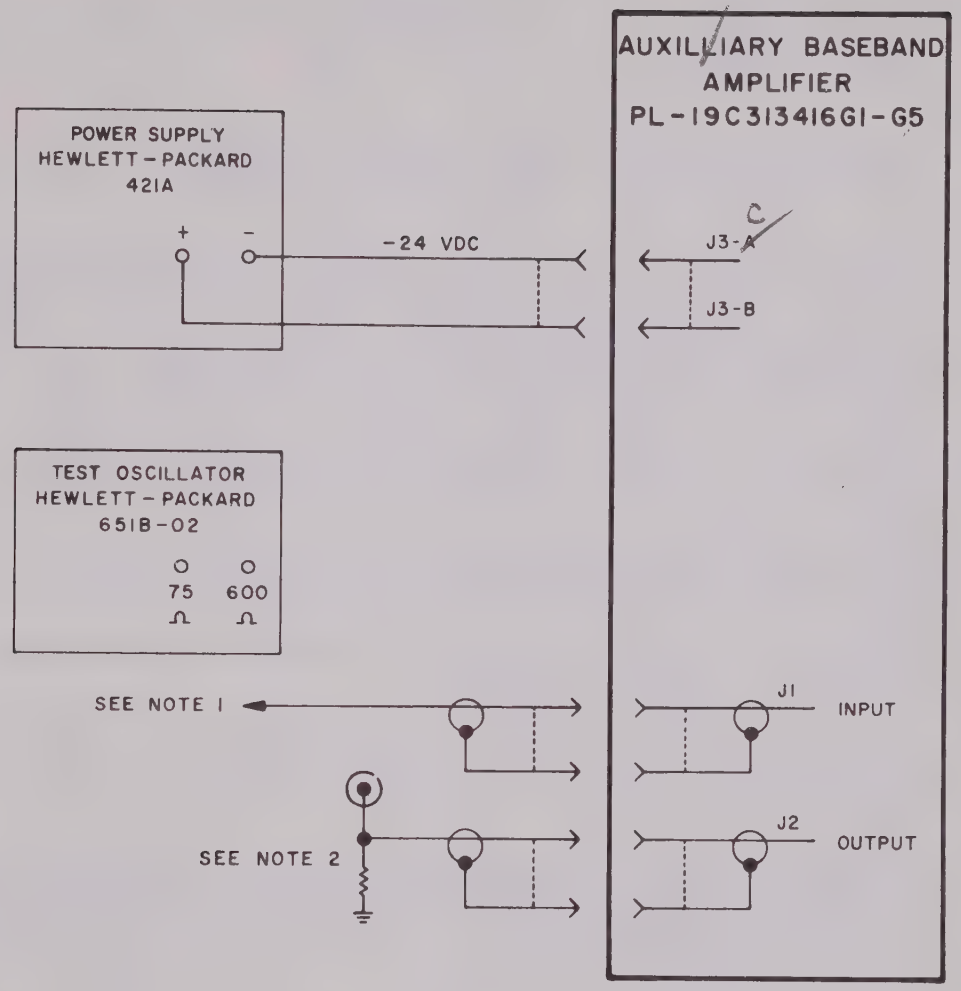
BIAS ADJUSTMENT

(1) Connect test equipment as illustrated in figure 4.

(2) Set output voltage of power supply to -24 Vdc.

(3) Connect dc voltmeter to emitter of Q3 and adjust A1R2 (on A1 circuit card) for -11.0 Vdc.

(4) Repeat step (3) for redundant unit (when A2 is used).



NOTES:

1. CONNECT TO TEST OSCILLATOR 75 OHM JACK FOR GROUPS 1, 2 AND 5 OR TO 600 OHM JACK FOR GROUPS 3 AND 4.
2. USE 75 OHM TERMINATION FOR GROUPS 1 THRU 4. USE 600 OHM TERMINATION FOR GROUP 5.

Figure 4. Auxiliary Baseband Amplifier Test Setup Diagram

FREQUENCY RESPONSE AND GAIN

(1) Set LEVEL ADJ control (R2) full cw.

(2) Set frequency of test oscillator to 300 kHz for G1 & G2; 50 kHz for G3, G4, & G5 and input level to auxiliary baseband amplifier to 20 millivolts rms. Use ac voltmeter for this measurement.

(3) Assure that output jack is properly terminated and connect ac voltmeter to J2. Note voltage reading on ac voltmeter. This is the output voltage reference level.

(4) Keep the input level to the auxiliary baseband amplifier constant and vary the frequency from 300 Hz to 8.5 MHz for G1 & G2, and 300 Hz to 500 kHz for G3, G4, & G5. The output level should not vary from reference more than +.05 dB from 300 Hz to 4.5 MHz and ±.2 dB from 300 Hz to 8.5 MHz. Adjust A1C1 as necessary to maintain this tolerance.

(5) On groups 1, 3, & 5, remove sensing board A3 and repeat above procedure adjusting A2C1 as necessary. Reinsert A3.

(6) Set frequency of test oscillator to 50 kHz and the input level to -35 dB. Use ac voltmeter to set level.

(7) Connect ac voltmeter to output jack J2. Ac voltmeter should indicate -17.9 dB or more.

(8) On groups 1, 3 & 5, remove sensing board A3. Output level should remain at the same level as in (7) above ±0.1 dB. Reinsert A3.

(9) On groups 1, 3, and 5, check operation of fault alarm lamps by adjusting the voltage on the emitter of A1Q3 and A2Q3 outside the range 8.5 ±1 Vdc to 13.5 ±1 Vdc, accomplished by adjusting R2 on A1 and A2.

(10) Reset R2 for 11.0 Vdc at the emitter of A1Q3 and A2Q3.

(11) Disconnect test equipment.

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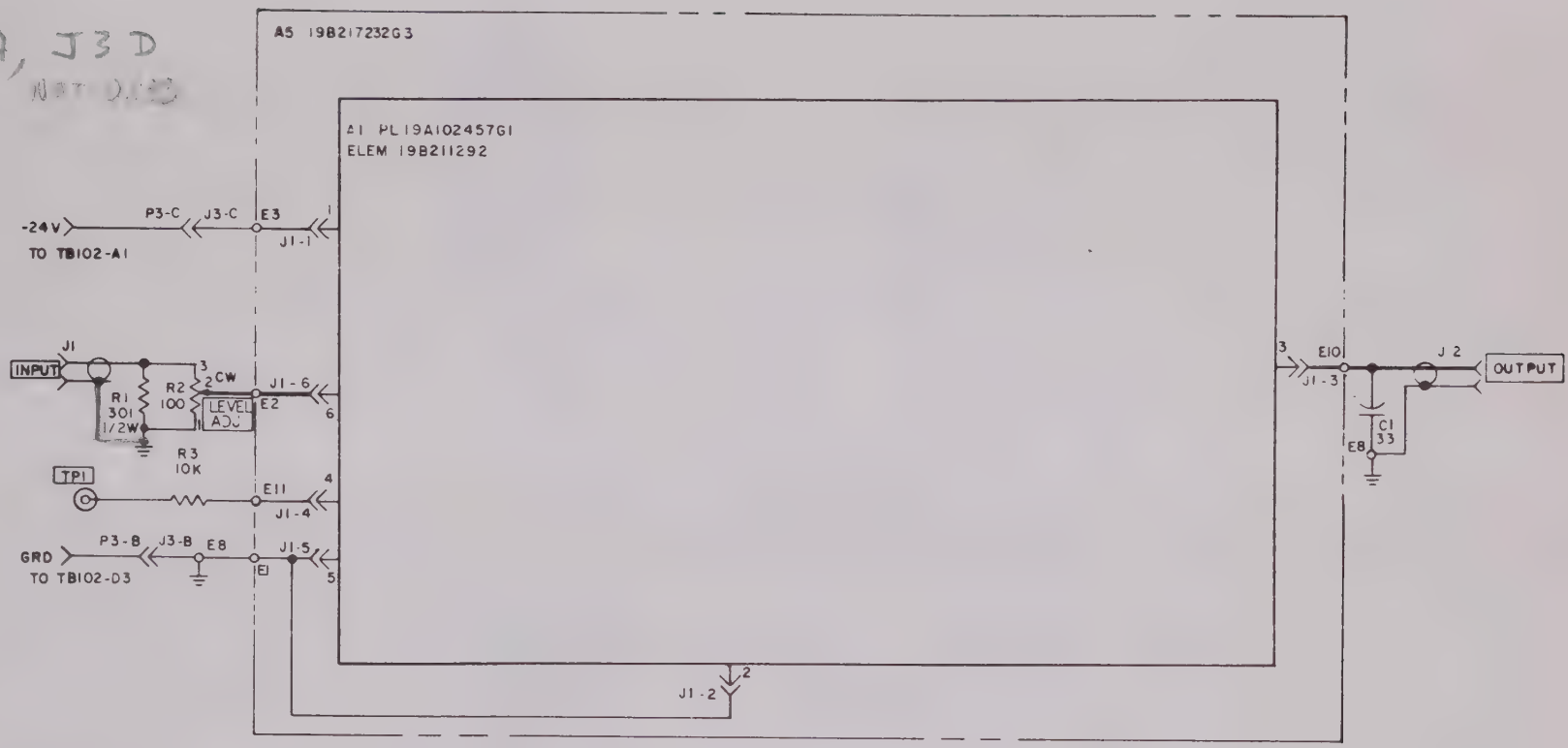


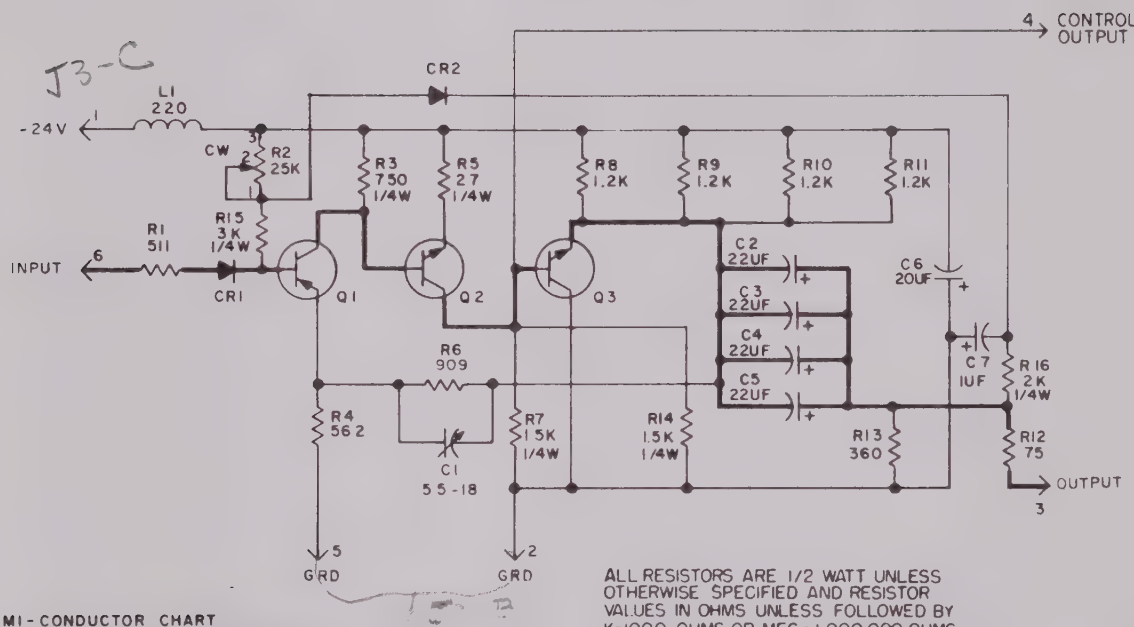
NOTES:

1. ALL RESISTORS ARE 1/4 WATT UNLESS OTHERWISE SPECIFIED AND RESISTOR VALUES IN OHMS UNLESS FOLLOWED BY K=1000 OHMS OR MEG=1,000,000 OHMS. CAPACITOR VALUES IN PICOFARADS (EQUAL TO MICROMICROFARADS) UNLESS FOLLOWED BY UF=MICROFARADS. INDUCTANCE VALUES IN MICROHENRYS UNLESS FOLLOWED BY MH=MILLIHENRYS OR H=HENRYS.
2. [ ] INDICATES FRONT PANEL MARKING
3. SUBASSEMBLY REF DESIGNATIONS ARE ABBREVIATED. PREFIX THE DESIGNATION WITH SUBASSEMBLY DESIGNATION.

Elementary Diagram

AUXILIARY BASEBAND AMPLIFIER
PL-19C313416-G2

(Drawing No. 19C313401, Rev. 3)



SEMI-CONDUCTOR CHART

ITEM NO	G.E. IDENT NO	SIMILAR TO * JEDEC REG NO
CR1, CR2	19A115250P1	
Q2, Q3	19A115591	2N2218A
Q1	19A115852	2N3906

*FOR REFERENCE ONLY NOT RECOMMENDED FOR EXACT REPLACEMENT

ALL RESISTORS ARE 1/2 WATT UNLESS OTHERWISE SPECIFIED AND RESISTOR VALUES IN OHMS UNLESS FOLLOWED BY K=1000 OHMS OR MEG=1,000,000 OHMS. CAPACITOR VALUES IN PICOFARADS (EQUAL TO MICROMICROFARADS) UNLESS FOLLOWED BY UF=MICROFARADS. INDUCTANCE VALUES IN MICROHENRYS UNLESS FOLLOWED BY MH=MILLIHENRYS OR H=HENRYS.

Elementary Diagram

AMPLIFIER BOARD
PL-19A102457-G1

(Drawing No. 19B211292, Rev. 2)

PARTS LIST

AUXILIARY BASEBAND AMPLIFIER
PL-19C313416-G2, -G4

SYMBOL	GE PART NO.	DESCRIPTION
		- - - - - - - - - - -CAPACITORS- - - - - - - - - - -
C1	7489162-P15	Silver mica: 33 pf ±5%, 500 VDCW; sim to Electro Motive Type DM-15.
		- - - - - - - JACKS AND RECEPTACLES- - - - - - - -
J1 and J2	7776570-P17	Receptacle, bulkhead: coaxial, 500 V peak. Military Type UG-1094/U.
J3	19B209409-P1	Connector, receptacle.
		- - - - - - - - - - - PLUGS- - - - - - - - - - -
P3	19B209409-P2	Connector, plug.
		- - - - - - - - - - RESISTORS- - - - - - - - - -
R1	5495948-P147	Deposited carbon: 301 ohms ±1%, 1/2 w; sim to Texas Instrument CD1/2MR. (Used in PL-19C313416-G2)
R1	5495948-P169	Deposited carbon: 511 ohms ±1%, 1/2 w; sim to Texas Instrument CD1/2MR. (Used in PL-19C313416-G4)
R2	7775427-P101	Variable: 100 ohms ±10%, 1/2 w; sim to Allen-Bradley Type G.
R3	3R152-P103J	Composition: 10,000 ohms ±5%, 1/4 w.
		- - - - - - - - - -TEST POINTS- - - - - - - - - -
TP1	4033567-P2	Test jack, stake-in: red nylon; sim to Alden Product Co. 110SMI.
		- - - - - - - - - SUBASSEMBLIES- - - - - - - - -
A1		AMPLIFIER BOARD ASSEMBLY 19A102457-G1
		- - - - - - - - - - -CAPACITORS- - - - - - - - - - -
C1	19C301246-P4	Variable, ceramic: 5.5 to 18 pf, sim to Erie Style 538.
C2 thru C5	5496267-P10	Tantalum: 22 µf ±20%, 15 VDCW; sim to Sprague Type 150D.
C6	19A115680-P3	Electrolytic: 20 µf +150%, -10%, 25 VDCW; sim to Mallory Type TT.
C7	5496267-P17	Tantalum: 1 µf ±20%, 35 VDCW; sim to Sprague Type 150D.
		- - - - - - - DIODES AND RECTIFIERS- - - - - - -
CR1 and CR2	19B200250-P1	Silicon.
		- - - - - - - - - - INDUCTORS- - - - - - - - - -
L1	7491382-P103	Coil, RF: 220 µh ±10%, 6 ohms DC res max; sim to Delevan 4500 Series.
		- - - - - - - - - -TRANSISTORS- - - - - - - - - -
Q1	19A115852-P1	Silicon, PNP; sim to Type 2N3906.
Q2 and Q3	19A115591-P1	Silicon, NPN; sim to Type 2N2218A.

SYMBOL	GE PART NO.	DESCRIPTION
		- - - - - - - - - - RESISTORS- - - - - - - - - -
R1	5495948-P169	Deposited carbon: 511 ohms ±1%, 1/2 w; sim to Texas Instrument CD1/2MR.
R2	19B209358-P107	Variable, carbon film: approx. 75 to 25,000 ohms ±20%, 0.25 w; sim to CTS Type X-201.
R3	3R152-P751J	Composition: 750 ohms ±5%, 1/4 w.
R4	5495948-P73	Deposited carbon: 56.2 ohms ±1%, 1/2 w; sim to Texas Instrument CD1/2MR.
R5	3R152-P270J	Composition: 27 ohms ±5%, 1/4 w.
R6	5495948-P193	Deposited carbon: 909 ohms ±1%, 1/2 w; sim to Texas Instrument CD1/2MR.
R7	3R152-P152J	Composition: 1500 ohms ±5%, 1/4 w.
R8 thru R11	3R77-P122J	Composition: 1200 ohms ±5%, 1/2 w.
R12	5495948-P85	Deposited carbon: 75 ohms ±1%, 1/2 w; sim to Texas Instrument CD1/2MR.
R13	3R77-P361J	Composition: 360 ohms ±5%, 1/2 w.
R14	3R152-P152J	Composition: 1500 ohms ±5%, 1/4 w.
R15	3R152-P302J	Composition: 3000 ohms ±5%, 1/4 w.
R16	3R152-P202J	Composition: 2000 ohms ±5%, 1/4 w.
A5		PRINTED CIRCUIT BOARD 19B217232-G3
		- - - - - - - - - - TERMINALS- - - - - - - - - -
E1 thru E7, E9 thru E11	19A115296-P1	Terminal, standoff: sim to Cambridge Thermionic Corp. X1558-BB.
		- - - - - - - - - - RESISTORS - - - - - - - - - -
R1 R2 R3		(These three resistors are on board but are not used in PL-19C313416-G2 and -G4 application.)

NOTE

RESISTORS 5495948, Deposited Carbon.

For replacement, use resistor 19A116278 (Metal film, 2%, 1/2 w; similar to Corning Style C5M). Corresponding part numbers and values of 5495948 and 19A116278 are the same for P1 thru P501. 5495948 P502 thru P534 are not available in 19A116278 resistor.

*COMPONENTS ADDED, DELETED OR CHANGED BY PRODUCTION CHANGES

PRINCIPLES OF OPERATION

INTERCONNECT AMPLIFIER PL-19C313467G1, G2

4.0 GENERAL

4.0.1 The interconnect amplifier is used to compensate for signal losses incurred between the low-density multiplex equipment and the TRS-696 radio rack. The baseband signal level of the service channel and multiplex channels (24 maximum) is amplified sufficiently to drive the transmitter baseband amplifier.

4.0.2 The interconnect amplifier is contained on a printed circuit card housed within a metal container and located on the interconnect shelf of the TRS-696 radio rack. All connectors, a test point, level adjustment control, and power plug are accessible from the front panel. The unit occupies two unit spaces.

4.1 SPECIFICATIONS

Input Impedance:	75 ohms, unbalanced
Output Impedance:	Less than 300 ohms, non-inductive, unbalanced
Frequency Response: (Reference 60 kHz)	±0.1 dB 300 Hz to 108 kHz
Gain:	53 dB (Group 1) 43 dB (Group 2)
Supply Voltage:	-24 vdc, 46 ma

4.2 DESCRIPTION

4.2.1 The interconnect amplifier is available in two groups. Group one has a maximum gain of 53 dB; group two has a maximum gain of 43 dB. The amplifier circuit is described with reference to elementary diagram 19B217074 (Group 1) or 19B217268 (Group 2). The amplifier is comprised of two sections each consisting of complimentary amplifiers and a driver stage. The first section consists of Q1, Q2, and Q3. The second section consists of Q4, Q5, and Q6. Bias for Q1 is set by voltage divider R4 and R5 and for Q4 by voltage divider R15 and R16.

4.2.2 The input signal connected to jack J1 appears across a parallel combination of resistors R1, R2, and R3. The resistors permit adjustment of the amplifier gain and maintain the input impedance at 75 ohms. R2 adjusts the overall gain of the amplifier. (The gain is variable from 1 to 53 dB (Group 1) or 1 to 43 dB (Group 2). The signal is then applied at a level determined by LEVEL ADJ control R2 to the base of Q1. The first two stages are complimentary emitter stages formed by PNP transistor Q1 and NPN transistor Q2. They drive common collector stage Q3. Negative feedback from the emitter of Q3 through

R8 is used to achieve stability, increase frequency response, and control the fixed gain of the amplifier.

4.2.3 The input signal to the second section of the amplifier is taken from the emitter of Q3 and applied to the base of Q4 through C5. The operation of the second section is identical to the first and will not be described here. The output signal is taken from J2 through output coupling capacitor C8.

4.2.4 The output signal may be monitored at TP1 on the front panel. Although the test point signal is taken from the collector of Q5, the signal at the test point is essentially the output signal since Q6 is an emitter follower with a gain of near unity. The purpose of Q6 is to provide amplifier buffering and isolation.

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INTERCONNECT AMPLIFIER
PL-19C313467-G1, G2

4.0 GENERAL

4.0.1 Bench maintenance procedures for the interconnect amplifier consist of distortion, gain, and frequency response measurements. Each of these tests is performed by applying a specified input signal and then monitoring the output for the required output signal. An oscilloscope is used to observe the output waveform to assure that it is free of distortion. The gain is checked by applying both maximum and minimum signal levels to the interconnect amplifier input. The maximum gain for the group 1 unit is 53 dB and for the group 2 unit it is 43 dB. The frequency response is checked using a frequency of 1000 Hz at a fixed input level to establish a reference point. While maintaining a constant input level, the output level should not vary more than ±0.5 dB from 300 Hz to 108 kHz.

4.0.2 Regulated -24 vdc source voltage at 50 ma is required to operate the interconnect amplifier.

4.0.3 Refer to drawing 19B217074 (group 1) or 19B217268 (group 2) for the elementary diagram and to drawing 19C315737 for the service outline. The service outline is used to locate and identify components and test points. TP1 is an output monitor test point It is followed in the circuit by an emitter follower whose gain is essentially unity and therefore has little effect on the output signal level.

4.1 TEST EQUIPMENT REQUIRED (or equivalent)

4.1.1 Test equipment required for maintenance of the interconnect amplifier is listed in figure 1. The test set up is illustrated in figure 2.

TEST EQUIPMENT	MODEL	REQUIREMENT
Ac Voltmeter (Hewlett-Packard	400EL	
Oscilloscope (Tektronix)	531	
Plug-in Unit	Type CA	
Power Supply (Hewlett-Packard)	721A	-24 vdc at 50 ma
Resistor	GE-5495948P261	4220 ohms, 1% 1/2 watt
Test Oscillator	651B-02	300 Hz to 108 kHz -19 dB to -54 dB

Figure 1. Test Equipment Required (or equivalent)

4.2 MAINTENANCE PROCEDURES

4.2.1 GAIN AND FREQUENCY RESPONSE

(1) Connect test equipment as illustrated in figure 2.

(2) Set output voltage of power supply to -24 vdc.

(3) Set output of test oscillator to 1000 ±10 Hz at a level of -41 dB (group 1) or -31 dB (group 2).

(4) Adjust potentiometer R2 for an 11 volt peak-to-peak sine wave on oscilloscope. The waveform should not be distorted.

(5) Using oscilloscope monitor TP1, the waveform should be 11 ±1 volt peak-to-peak.

(6) Set output level of test oscillator to -29 dB (group 1) or -19 dB (group 2). Set R2 full ccw. Output level indicated on ac voltmeter should be less than -1 dB.

(7) Set output level of test oscillator to -54 dB (group 1) or -44 dB (group 2). Set R2 full cw. Output level indicated on ac voltmeter shall be greater than -1 dB.

(8) Set output level of test oscillator to -44 dB (group 1) or -34 dB (group 2). Adjust R2 for an output level of -1 dB. Keep the output level of the test oscillator constant and vary the frequency from 300 Hz to 108 kHz. The output level of the interconnect amplifier should not exceed -1 ±0.5 dB over the entire range.

(9) Disconnect test equipment.

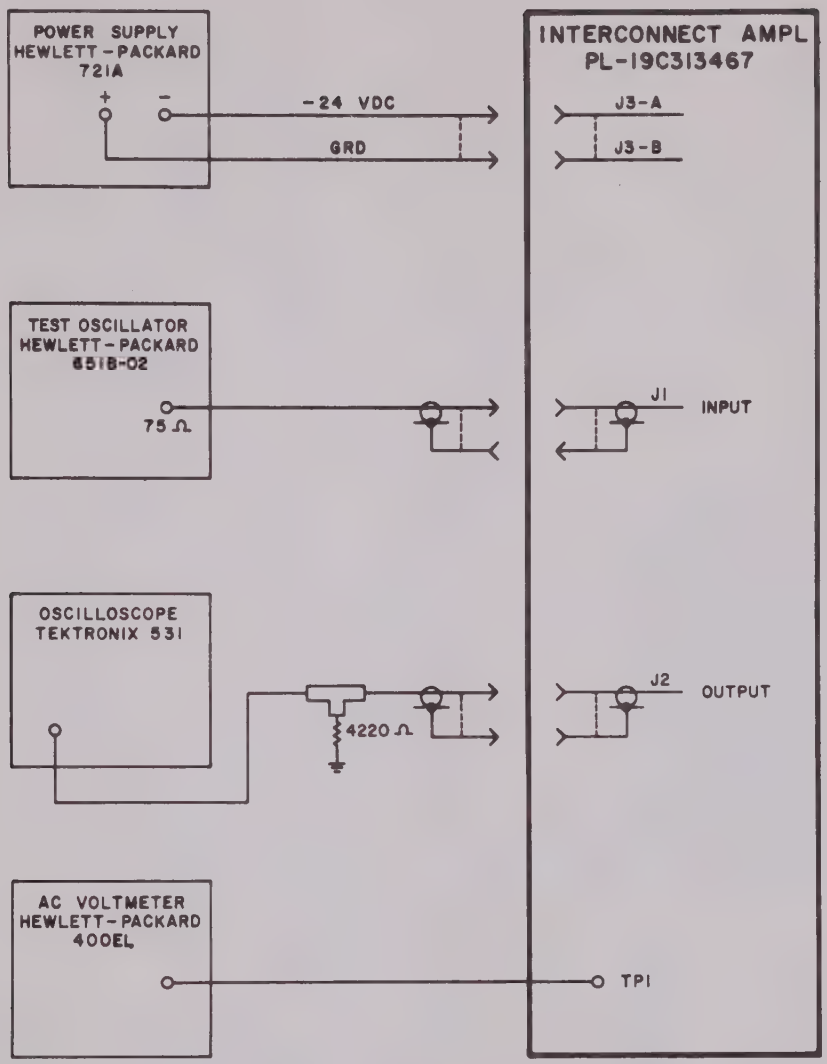
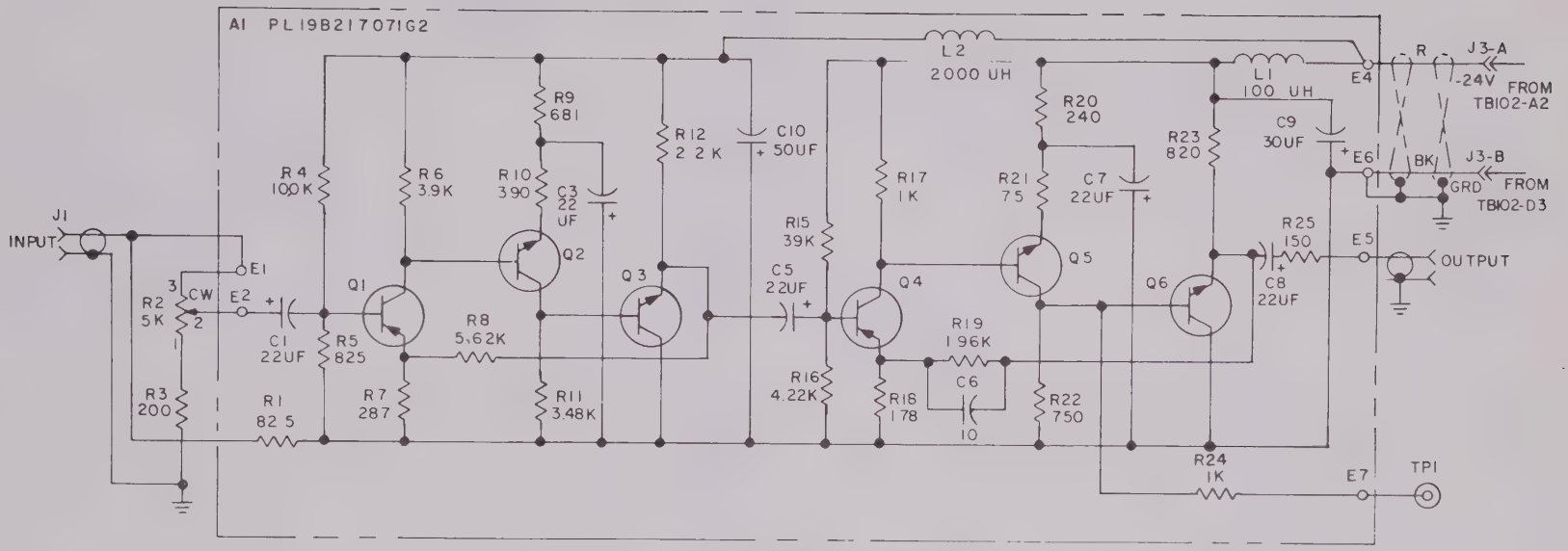


Figure 2. Interconnect Amplifier Test Setup Diagram

COMMUNICATION PRODUCTS DEPARTMENT
GENERAL ELECTRIC COMPANY
LYNCHBURG, VIRGINIA

Printed in U.S.A.



ITEM NO	GE IDENT NO	SIMILAR TO X JEDEC REG NO
Q1, Q4	19A115652P1	2N3906
Q2, Q3	19A115910P1	2N3904
Q5, Q6	19A115300P1	2N3053

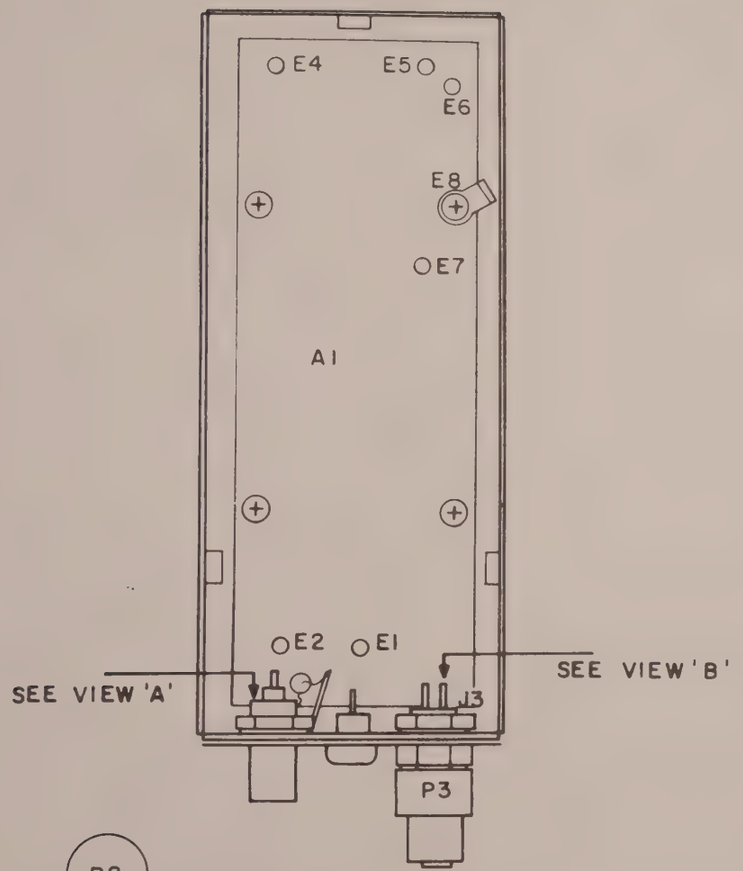
* FOR REF ONLY NOT RECOMMENDED FOR EXACT REPLACEMENT

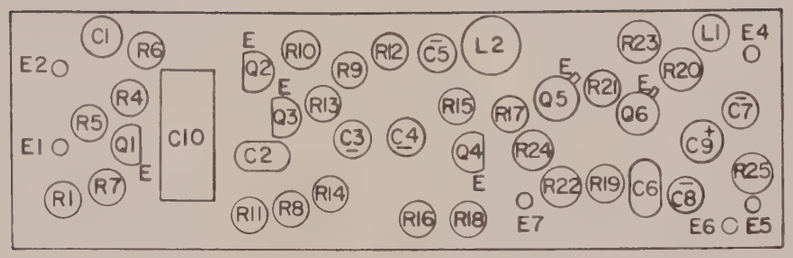
NOTES
1. ALL RESISTORS ARE 1/2 WATT UNLESS OTHERWISE SPECIFIED AND RESISTOR VALUES IN OHMS UNLESS FOLLOWED BY K=1000 OHMS OR MEG = 1,000,000 OHMS. CAPACITOR VALUES IN PICOFARADS (EQUAL TO MICROMICROFARADS) UNLESS FOLLOWED BY UF = MICROFARADS. INDUCTANCE VALUES IN MICROHENRYS UNLESS FOLLOWED BY MH = MILLIHENRYS OR H = HENRYS.
2. P3, MATING PLUG FOR J3 IS SUPPLIED WITH UNIT
3. TB102 LOCATED ON RACK ASM INTERCONNECT PANEL

Elementary Diagram

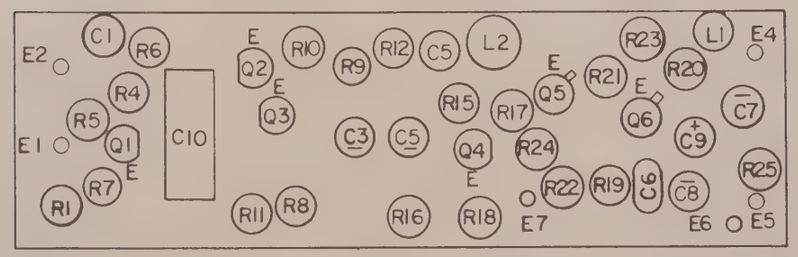
INTERCONNECT AMPLIFIER
PL-19C313467-G2

(Drawing No. 19B217268, Rev. 2)

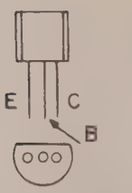




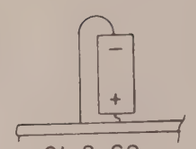
A1 (FOR GROUP 1)

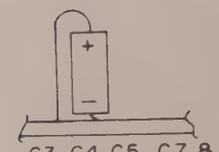


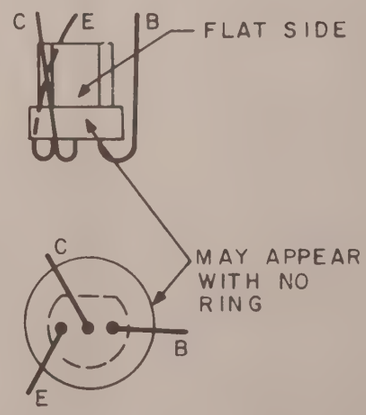
A1 (FOR GROUP 2)



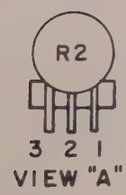
LEAD IDENT.
FOR Q1-Q4





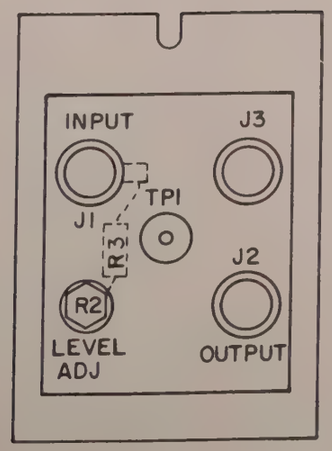


LEAD IDENTIFICATION FOR Q5 & Q6



VIEW "A"

VIEW "B"



Service Outline

INTERCONNECT AMPLIFIER
PL-19C313467-G1 & G2

(Drawing No. 19C315737, Rev. 1)

PARTS LIST

INTERCONNECT AMPLIFIER
19C313467-G1, G2

SYMBOL	G-E PART NO.	DESCRIPTION
A1		COMPONENT BOARD ASSEMBLY 19B217071-G1 19C313467-G1 19B217071-G2 19C313467-G2
		- - - - - - - - - - CAPACITORS - - - - - - - - - -
C1	5496267-P19	Tantalum: 22 µf ±20%, 35 VDCW; sim to Sprague Type 150D.
C2	5490008-P6	Silver mica: 10 pf ±5%, 500 VDCW; sim to Electro Motive Type DM-15. (Used in 19C313467-G1 only).
C3	5496267-P19	Tantalum: 22 µf ±20%, 35 VDCW; sim to Sprague Type 150D.
C4	5496267-P19	Tantalum: 22 µf ±20%, 35 VDCW; sim to Sprague Type 150D. (Used in 19C313467-G1 only).
C5	5496267-P19	Tantalum: 22 µf ±20%, 35 VDCW; sim to Sprague Type 150D.
C6	5490008-P6	Silver mica: 10 pf ±5%, 500 VDCW; sim to Electro Motive Type DM-15.
C7 and C8	5496267-P19	Tantalum: 22 µf ±20%, 35 VDCW; sim to Sprague Type 150D.
C9	19A115680-P17	Electrolytic: 30 µf +150% -10%, 25 VDCW; sim to Mallory Type TT.
C10	19A115680-P4	Electrolytic: 50 µf +150% -10%, 25 VDCW; sim to Mallory Type TT.
		- - - - - - - - - - INDUCTORS - - - - - - - - - -
L1	7491382-P101	Coil, RF: 100 µh ±10%, 4 ohms DC res max; sim to Delevan 3500 Series.
L2	7491382-P108	Coil, RF: 2000 µh ±10%, 30 ohms DC res max; sim to Delevan 3500 Series.
		- - - - - - - - - - TRANSISTORS - - - - - - - - - -
Q1	19A115852-P1	Silicon, PNP; sim to Type 2N3906.
Q2 and Q3	19A115910-P1	Silicon, NPN; sim to Type 2N3904.
Q4	19A115852-P1	Silicon, PNP; sim to Type 2N3906.
Q5 and Q6	19A115300-P1	Silicon, NPN; sim to Type 2N3053.
		- - - - - - - - - - RESISTORS - - - - - - - - - -
R1	5495948-P89	Deposited carbon: 82.5 ohms ±1%, 1/2 w; sim to Texas Instrument CD1/2MR.
R4	5495948-P301	Deposited carbon: 10,000 ohms ±1%, 1/2 w; sim to Texas Instrument CD1/2MR.
R5	5495948-P189	Deposited carbon: 825 ohms ±1%, 1/2 w; sim to Texas Instrument CD1/2MR.
R6	3R77-P392J	Composition: 3900 ohms ±5%, 1/2 w.
R7	5495948-P145	Deposited carbon: 287 ohms ±1%, 1/2 w; sim to Texas Instrument CD1/2MR.
R8	19A116278-P273	Metal film: 5620 ohms ±2%, 1/2 w; sim to Corning Style CSM. (Used in 19C313467-G2 only.)
R8	5495948-P269	Deposited carbon: 5110 ohms ±1%, 1/2 w; sim to Texas Instrument CD1/2MR. (Used in 19C313467-G2 only).
R9	5495948-P181	Deposited carbon: 681 ohms ±1%, 1/2 w; sim to Texas Instrument CD1/2MR.
R10	3R77-P391J	Composition: 390 ohms ±5%, 1/2 w.
R11	5495948-P253	Deposited carbon: 3480 ohms ±1%, 1/2 w; sim to Texas Instrument CD1/2MR.
R12	3R77-P821J	Composition: 820 ohms ±5%, 1/2 w. (Used in 19C313467-G1 only).
R12	3R77-P222J	Composition: 2200 ohms ±5%, 1/2 w. (Used in 19C313467-G2 only).
R13	5495948-P161	Deposited carbon: 422 ohms ±1%, 1/2 w; sim to Texas Instrument CD1/2MR.
R14	5495948-P233	Deposited carbon: 21500 ohms ±1%, 1/2 w; sim to Texas Instrument CD1/2MR.
R15	3R77-P393J	Composition: 39,000 ohms ±5%, 1/2 w.
R16	5495948-P261	Deposited carbon: 4220 ohms ±1%, 1/2 w; sim to Texas Instrument CD1/2MR.
R17	3R77-P102J	Composition: 1000 ohms ±5%, 1/2 w.
R18	5495948-P125	Deposited carbon: 178 ohms ±1%, 1/2 w; sim to Texas Instrument CD1/2MR.
R19	5495948-P225	Deposited carbon: 1780 ohms ±1%, 1/2 w; sim to Texas Instrument CD1/2MR. (Used in 19C313467-G1 only).
R19	5495948-P229	Deposited carbon: 1960 ohms ±1%, 1/2 w; sim to Texas Instrument CD1/2MR. (Used in 19C313467-G2 only).
R20	3R77-P241J	Composition: 240 ohms ±5%, 1/2 w.
R21	3R77-P750J	Composition: 75 ohms ±5%, 1/2 w.
R22	3R77-P751J	Composition: 750 ohms ±5%, 1/2 w.
R23	3R77-P821J	Composition: 820 ohms ±5%, 1/2 w.
R24	3R77-P102J	Composition: 1000 ohms ±5%, 1/2 w.
R25	3R77-P151J	Composition: 150 ohms ±5%, 1/2 w.
		- - - - - - - - - - JACKS AND RECEPTACLES - - - - -
J1 and J2	7776570-P17	Receptacle, bulkhead: coaxial, 500 v peak. Military Type UG-1094/U.
J3	19B217009-G1	Connector assembly. Includes:
	19B209409-P1	Receptacle.
	19B209409-P2	Plug.
		- - - - - - - - - - RESISTORS - - - - - - - - - -
R2	19B209368-P10	Variable, carbon film: 5000 ohms ±20%, 350 VDCW; sim to CTS Type 200.
R3	3R77-P201J	Composition: 200 ohms ±5%, 1/2 w.
		- - - - - - - - - - TEST POINTS - - - - - - - - - -
TP1	4033567-P2	Test jack, stake-in: red nylon; sim to Alden 110SMI.
		- - - - - - - - - - MISCELLANEOUS - - - - - - - - - -
	4036555-P1	Insulator, disc. (Used with Q5 and Q6).

NOTE

RESISTORS 5495948, Deposited Carbon.

For replacement, use resistor 19A116278 (Metal film, 2%, 1/2 w; similar to Corning Style CSM). Corresponding part numbers and values of 5495948 and 19A116278 are the same for P1 thru P501. 5495948 P502 thru P534 are not available in 19A116278 resistor.

*COMPONENTS ADDED, DELETED OR CHANGED BY PRODUCTION CHANGES.

PRINCIPLES OF OPERATION

SERVICE CHANNEL INTERCONNECT PAD PL-19B208954G1

4.0 GENERAL

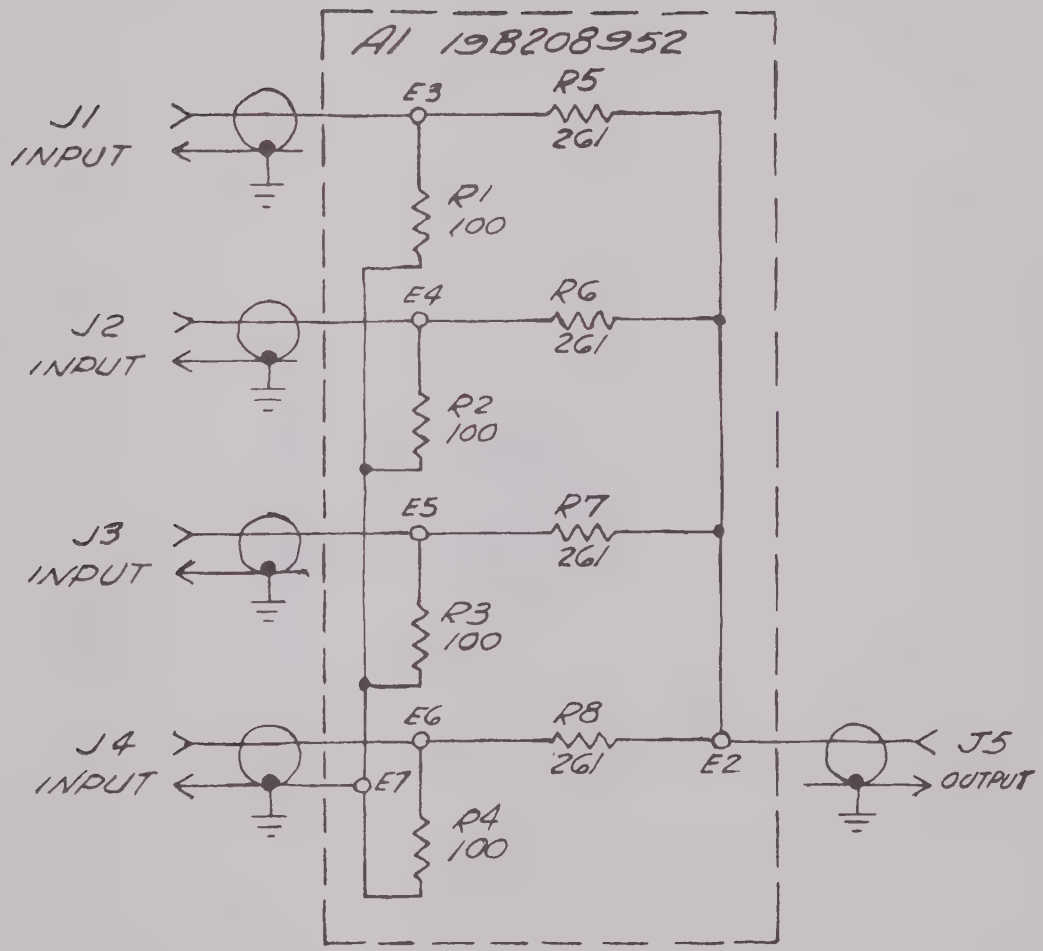
4.0.1 The service channel interconnect pad is used to combine the service channel input signal from a maximum of four TRS-696 microwave radios and provide a single service channel signal to the TCS-24 low density multiplex system. It is mounted in a metal container with BNC jacks on the front panel for easy interconnect accessibility and is located on the interconnect shelf at the top of the radio rack. The input jacks are identified as J1, J2, J3, and J4. The common output jack is J5.

4.1 SPECIFICATIONS

Input Impedance:	75 ohms
Output Impedance:	75 ohms
Insertion Loss:	17 db (from J1-J4 to J5)
Isolation:	34 db (between any two inputs)

4.2 DESCRIPTION

4.2.1 The service channel interconnect pad consists of a resistive combining network with an input and output impedance of 75 ohms. Since all input jacks may not be used at one time, it is important that all unused jacks be terminated in 75 ohms. Refer to drawing 19A102427 for the circuit diagram and to drawing 19B210411 for the service outline.

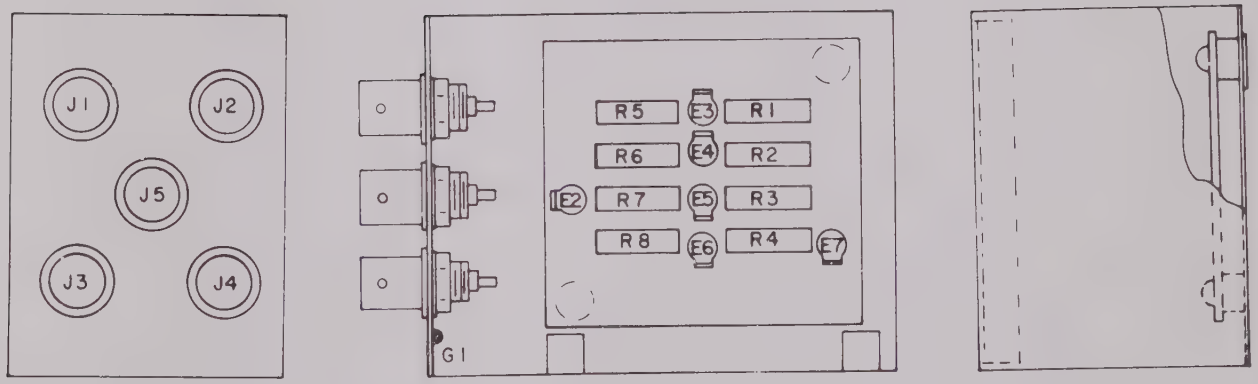


NOTE
(1.) ALL RESISTORS ARE 42 WATT UNLESS OTHERWISE SPECIFIED AND RESISTOR VALUES IN OHMS

Elementary Diagram

SERVICE CHANNEL INTERCONNECT PAD
PL-19B208954-G1

(Drawing No. 19A102427, Rev. 1)



Service Outline

SERVICE CHANNEL INTERCONNECT PAD
PL-19B208954-G1

(Drawing No. 19B210411, Rev. 0)

PARTS LIST

SERVICE CHANNEL INTERCONNECT PAD
19B208954-G1

SYMBOL	G-E PART NO.	DESCRIPTION
A1		COMPONENT BOARD ASSEMBLY 19B208952-G1
		- - - - - - - - JACKS AND RECEPTACLES - - - - - - - -
J1 thru J5	7776570-P17	Receptacle, bulkhead: coaxial, 500 v peak. Military Type UG-1094/U.
		- - - - - - - - - - - RESISTORS - - - - - - - - - - -
R1 thru R4	5495948-P101	Deposited carbon: 100 ohms ±1%, 1/2 w; sim to Texas Instrument CD1/2MR.
R5 thru R8	5495948-P141	Deposited carbon: 261 ohms ±1%, 1/2 w; sim to Texas Instrument CD1/2MR.

*COMPONENTS ADDED, DELETED OR CHANGED BY PRODUCTION CHANGES.

PRINCIPLES OF OPERATION

POWER SUPPLY UNIT
PL-19E500125-G4

GENERAL

The power supply unit provides all the voltages required to operate a basic rack of rf equipment. Two units are used to supply the voltages required to operate a diversity or standby rack of rf equipment. The unit operates from a 48 Vdc source and provides five regulated outputs. One of these is furnished by a switching regulator circuit, and the remaining four are furnished by a dc-to-dc converter circuit. These circuits are constructed on a chassis mounted to a door assembly. A circuit breaker and an indicator lamp are located on front of the door. One power supply is mounted at the bottom of a basic rack; two are mounted at the bottom of a diversity or a standby rack.

SPECIFICATIONS

Input Voltage:	-42 to -57 Vdc, positive ground
Output Voltages:	+26 Vdc, 0.8 amp.
	-32 Vdc, 0.3 amp.
	-24 Vdc, 2.0 amp.
	+24 Vdc, 0.5 amp.
	+4 Vdc, 0.25 amp.

CIRCUIT DESCRIPTION

The power supply circuit description is divided into two parts: (1) the switching regulator circuit, and (2) the dc-to-dc converter circuit. Refer to Elementary Diagram 19E501320.

SWITCHING REGULATOR CIRCUIT

The switching regulator circuit consists of a transistor switch connected between the -48 volt input and an LC filter. The switch is operated by a differential amplifier and a Schmitt trigger arrangement. A well regulated -24 volt output, which is connected to the dc-to-dc converter circuit, is achieved by accurate control of the switching levels. The circuit is arranged so the switch is turned on when the voltage at the output of the filter drops below 24 volts and off when it rises above 24 volts. Protective circuits in the form of a starting circuit, an over-current circuit and an over-voltage circuit are associated with the regulator circuit.

The -48 volt input applied at terminal 11 is connected through circuit breaker CB1 and input filter L1-C5 to one side of transistor switch Q1. When Q1 is turned on this voltage is applied to LC filter L2-C4-C8-C9-C6. Zener diodes VR6-VR7-VR8, resistors R27-R29 and potentiometer R28 form a voltage divider across the filter output. Indicator lamp DS1 is also connected across the filter output. Potentiometer R28 is used to adjust regulator output, and a voltage taken from it is applied to a differential amplifier.

Transistors Q7-Q8 form a differential amplifier. A reference voltage, supplied by zener diode VR5, is connected to the base of Q7. Voltage from the divider across the filter output is taken from R28 and applied to the base of Q8. Any difference that may exist between these two voltages is amplified and applied to the Schmitt trigger circuit.

The Schmitt trigger circuit consists of transistors Q4 and Q6. Differential amplifier output from the collector of Q8 is applied to the base of Q6 through R24. Transistor Q4 is connected into driver stages Q2 and Q3 which in turn control switch Q1. When filter output voltage rises above 24 volts, the voltage at the collector of Q8 drops. This causes the trigger circuit to switch; Q6 is turned off and Q4 is turned on. Consequently the voltage at the collector drops and driver stages Q2-Q3 and switch Q1 are turned off. The circuit will remain in this condition until the output of the filter drops below 24 volts. Since no power is being supplied to the filter, the voltage at its output begins to drop. As this voltage drops, the voltage at the collector of Q8 increases; When it drops below 24 volts the voltage at Q8 has increased sufficiently to turn Q6 on. The trigger circuit is thus switched; Q6 is on and Q4 is off. This causes the voltage at the collector of Q4 to increase, and drivers Q2-Q3 and switch Q1 are turned on. The switching action described above assures a well regulated output voltage by controlling the flow of current into the filter output capacitor, and the regulator circuit provides a well regulated, low impedance, 24 volt source.

STARTING CIRCUIT

When the power supply is turned on, switch Q1 will be turned on and will remain on until the regulator output voltage builds up to a value just over 24 volts. If during this period of time the output is shorted, the current through Q1 could become excessive and damage the transistor. To prevent this, the starting current is limited to a safe value by the starting circuit consisting of R52, R59, zener diode VR9 and relay K1.

Relay K1 is deenergized when the power supply is turned on, and starting current is limited by the 2-ohm resistor (R52) connected in series between the regulator output and the load. Approximately 40 ms after the power supply is turned on, the voltage across the coil of K1 is sufficient to energize the relay. This removes R52 from the circuit and the regulator output is connected to the load through relay contacts 3-2, 10-11 and 7-8.

PROTECTIVE CIRCUITS

An over-current and an over-voltage detector are provided for the regulator output. Both control transistor Q5 and relay K3 which can activate a silicon-controlled rectifier capable of shorting the input voltage to ground through a one-ohm resistor. This, in turn, activates the circuit breaker to disconnect the power supply from the 48 volt line.

Over-current detector relays K2 and K3 are connected in series with regulator output. Note that the coil of relay K2 carries the total load current but the coil of K3 carries only the current supplied to the transmitter through L12 - C13 and to terminal 8 plus that supplied to the receiver through filter C39-L3-C17 and terminal 14. When current through the coil on K2 is sufficient to energize the relay, a negative voltage from the input is applied through the relay contacts to the voltage divider consisting of R16-R13-R12 and zener diodes VR1 and VR3. The voltage at the junction of R12-R13 will forward bias diode CR2 and turn Q5 on. This triggers SCR1 and the input voltage is shorted to ground through one-ohm resistor R2. Circuit breaker CB1 is tripped to disconnect the power supply from the 48 volt line. Since the current through the coil of K2 during start-up may momentarily be sufficient to energize the relay, resistor R13 and capacitor C2 introduce a delay to prevent the triggering of SCR1 during this period of time. Relay K3 will be energized when the current drawn by the transmitter and/or receiver becomes excessive. This will cause SCR1 to be triggered and switch Q1 to be turned off simultaneously. A negative voltage from the input is applied to diodes CR29 and CR30 through the contacts of K3. Both diodes will be forward biased. The voltage applied to the base of Q5 through R58 will turn Q5 on and SCR1 will be tripped. The voltage applied to the base of Q11 through R57 will turn Q11 on; this will cause drivers Q2-Q3 and switch Q1 to turn off.

Diode CR28 is the over-voltage detector. It is connected to the base of Q5 through R47 on one side, and to the voltage divider across the regulator output at a point between VR6 and VR7 on the other. When the voltage at this point exceeds about 30 volts, CR28 is forward biased and Q5 is turned on to trip SCR1.

DC-TO-DC CONVERTER CIRCUIT

The dc-to-dc converter consists of a transistor switch circuit that chops the 24 volt input from the regulator into a symmetrical square wave which is transformed to the appropriate levels and rectified to produce the desired output voltages. All power supply output voltages, except the -24 volt outputs supplied to the transmitter and receiver and the -48 output, are thus produced.

SWITCH CIRCUIT

The switch circuit consists of transistors Q9-Q10, saturable-core base drive transformer T1, and non-saturating output transformer T2. Regulated 24 volt input from the regulator is applied to the circuit through L4. Due to the saturation characteristics of T1, transistors Q9 and Q10 are turned on and off in alternate succession. The symmetrical square wave thus produced is transformed to the desired output levels by T2.

Forward bias for starting is applied to transistors Q9 and Q10 through R30. Because of small inherent imbalances in the circuit (difference in Beta of the transistors, for example), one of the two transistors will start to conduct more than the other. Assume Q9 conducts more than Q10. The current in that portion of the center-tapped primary winding on T2 connected to the collector of Q9 is thereby increased. The voltage induced in the secondary winding coded R-G on T2 is applied to the primary winding coded GR-GW on T1 through current limiting resistor R31. This causes voltages to be induced in the center-tapped winding on T1 that is connected to the base of Q9-Q10 such that Q9 is driven to saturation and Q10 is turned off. As the core of T1 saturates its primary current increases; therefore the drop across R31 increases and the drive voltage applied to the base of Q9 will be correspondingly decreased. When the voltage applied to the base of Q9 decreases to the point where the transistor cannot remain saturated, a drop in its collector current occurs. This results in a reversal in direction of magnetic flux change in T2, and therefore a reversal in the polarities of the voltages induced in all transformer windings. Transistor Q9 is then turned off and Q10 driven into saturation, and the core of T1 starts toward saturation in the opposite direction. Thus transistors Q9 and Q10 are turned on and off in alternate succession to produce a symmetrical square wave whose frequency, due to the saturation characteristics of T1, is approximately 2.3 kHz. This is transformed to the required levels in four secondary windings on T2 to obtain the desired outputs.

+26 VOLT OUTPUT

The +26 volt supply consists of center-tapped secondary coded RW-GW-RW, full-wave rectifier CR7-CR8, filter L13-C5-C11-C12-C43 and bleeder resistor R2. The +26 volt output is connected to terminal 13.

-32 VOLT OUTPUT

The -32 volt supply consists of center-tapped secondary coded W-BRR-W, full-wave rectifier CR1-CR2, filter L14-C1-C2-C3-C5 and bleeder resistor R1. The -32 volt output is connected to terminal 15.

+4 VOLT OUTPUT

Voltage induced in the center-tapped secondary winding coded WV-BR-WV is applied to full-wave rectifier CR3-CR4. Rectifier output is filtered by L8-C3-C7-C8 and is applied to output terminal 7 through CR1. The four volt output is used only in the standby rack. In this configuration, the four volt outputs of the two power supplies in the rack are connected in parallel. Each circuit contributes current to their common load through the diode (CR1) in series with its output. Should one of the circuits fail, the diode in series with its output is reverse biased, and the faulted circuit is, in effect, disconnected from the load.

+24 VOLT OUTPUT

The +24 volt supply consists of center-tapped secondary coded BL-WBLR-BL, full-wave rectifier CR5-CR6, filter L9-C4-C9-C10-C29 and bleeder resistor R51. Its output is connected to output terminal 12.

-48 VOLT OUTPUT

A -48 volt output is made available by a connection from the -48 volt input to output terminal 10 through diode CR27.

TELECOMMUNICATION PRODUCTS DEPARTMENT
GENERAL ELECTRIC COMPANY
LYNCHBURG, VIRGINIA Printed in U.S.A.

POWER SUPPLY MAINTENANCE
PL-19E500125-G4

GENERAL

Power supply maintenance is divided into five major parts consisting of: (1) visual inspection, (2) controls and indicators, (3) inservice checkout, (4) removal and replacement and (5) bench maintenance procedures.

VISUAL INSPECTION

A visual inspection of the power supply should include the following:

(1) When the power plug is disconnected for maintenance purposes always check for damaged pins or contacts.

(2) Be sure ground wire from power supply is securely connected to rack ground bus.

CONTROLS AND INDICATORS

Controls and indicators on the power supply consist of the input circuit breaker CB1, power indicator lamp DS1, regulator chopper frequency adjust potentiometer R14, and voltage adjust potentiometer R28. CB1 applies -48 Vdc input power to the power supply. DS1, when lit, verifies the presence of -24 Vdc. R14 varies the frequency of the switching regulator chopper and R28 controls the output voltage.

INSERVICE CHECKOUT PROCEDURE

Inservice checkout procedures for the power supply consist of monitoring each of the output voltages on the rack meter. Refer to Figure 1 for the meter selector switch positions and the correct indication.

METER FUNCTION	INDICATION
AMPL V	Red line ±3 small divisions (UT-10-C only)
OSC V	0.8 red line ±2 major divisions
-24 V	Red line ±3 small divisions
+24 V	Red line ±3 small divisions

Figure 1. Meter Functions and Indicators

The output voltages of the power supply are preset at the factory. Because a single adjustment will affect all output voltages, it is recommended that no inservice voltage adjustments be made to the power supply. Therefore, should one or more of the monitored voltages exceed tolerances, it is recommended that the meter circuitry be checked prior to removing and servicing the power supply.

CAUTION

The output voltages may be monitored on the rear of the supply by removing the top cover of the power plug. Removal of the cover exposes all supply voltages and caution must be exercised when measuring the voltages to prevent shorting, since this may damage or destroy the solid state RF devices.

It is possible, although not recommended, to measure the voltages at the power supply at power plug P109 or P110. A pictoral diagram of the plug showing pin location and the voltage present at each pin is given below. All voltages are measured with respect to ground using a Hewlett-Packard 412A or equivalent with an input impedance greater than 10,000 ohms.

	(2) — (1)	
	(4) — (3)	
	(6) — (5)	
-24 Vdc Xmtr	(8) — (7)	+4 Vdc
-48 Vdc output	(10) — (9)	
+24 Vdc	(12) — (11)	-48 Vdc Input
-24 Vdc Rcvr.	(14) — (13)	+26 Vdc Ampl. V
	(16) — (15)	-32 Vdc Osc. V

J109/J110

REMOVAL AND REPLACEMENT

Removal and replacement procedures consist of replacing the power supply as a unit as specified below.

(1) Set ON-OFF circuit breaker on front panel to OFF.

(2) Open power supply door and disconnect power plug from J109 and ground strap from rack ground bus.

NOTE

The power supply door is physically mounted to the rack using interlocking pins between doors. Refer to applicable power supply assembly drawings in chapter 6. Do not open adjoining doors when a power supply is removed. Under these conditions the adjoining doors are not secured by the pins.

(3) Stabilize the door with one hand and using a small screwdriver, push the guide pins upward one at a time and remove the door.

(4) Install new door by inserting lower pin first and then depressing the upper pin and repositioning the door so that upper pin locks into place.

BENCH MAINTENANCE

GENERAL

Bench maintenance procedures for the power supply consist of: (1) output voltage adjustment, (2) spike and ripple measurement, (3) chopper regulator frequency adjustment, and (4) overload protection circuit checkout. Also included is a malfunction isolation chart (Figure 3) to aid in isolating a malfunction. The procedures should be performed in the sequence given.

TEST EQUIPMENT	MODEL	REQUIREMENT
Components	270	See Figure 4
Multimeter (Simpson)		100 mA scale 500 mA scale 10 ampere scale
Oscilloscope (Tektronix)	531	
Plug-in Unit (Tektronix)	CA	
Power Supply (Harrison)	6439A	57 Vdc at 8 amperes

Figure 2. Test Equipment Required (or equivalent)

Refer to Elementary Diagram 19E501320 for the power supply circuit diagram, and to drawing 19E501334 for the service outline. The service outline may be used to locate and identify controls, E pins and components.

The test equipment required is listed in Figure 2. The test setup diagram is shown in Figure 4. The test jig must be fabricated using the components identified in Figure 4. All test points should be on the test jig front panel.

OUTPUT VOLTAGE ADJUSTMENT

(1) Connect test equipment as illustrated in Figure 4. Remove cover from power supply.

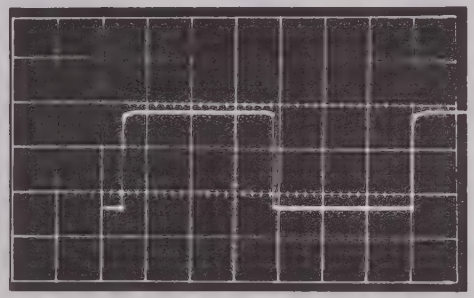
(2) On the power supply being serviced, set ON-OFF circuit breaker to ON.

STEP	MALFUNCTION	TROUBLE ANALYSIS	CORRECTIVE ACTION
1	Circuit breaker kicks out	A. DC to DC converter not operating	Remove input voltage lead from TB3-1 on bottom of power supply. Recycle circuit breaker. If relay now holds in connect oscilloscope to Q1-C and observe waveform. Waveform should appear as shown in figure 5. Reconnect input voltage lead.
		B. -24 Vdc to high	Connect oscilloscope to -24 volt output and recycle circuit breaker. If -24 volt output increases above -24 volts check for following shorted components: Q1, Q2, Q3, Q6, Q7, or for shorted capacitor or diode in regulator circuit.
		C. -24 Vdc to low	Recycle circuit breaker three times and then check R2 for heating. If R2 is warm check output circuits for overload or shorts. If R2 is cold check circuit breaker and input capacitor C1.
2	Circuit breaker does not kick out	A. -24 Vdc to high	Check VR6, VR7, and VR8 for shorts.
		B. -24 Vdc to low	Check K1; it should be energized. Check VR5 for short.
		D. No -24 Vdc output voltage	Check Q4, Q5, Q8, Q11, VR2, VR3, and VR4 for short.
3	No outputs except -24 Vdc	A. DC to DC converter not operating	Connect oscilloscope to collector of Q9. Waveform should appear as shown in figure 6. If waveform is not present check for the following:

Figure 3. Malfunction Isolation Chart (1 of 2)

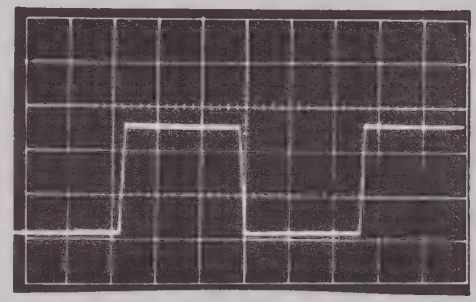
STEP	MALFUNCTION	TROUBLE ANALYSIS	CORRECTIVE ACTION
4	All output voltages low except -24 Vdc	A. T2 shorted B. Shorted rectifier diodes	(1) Q9, Q10 defective (2) Transformer T2 for shorts. Replace components as required.
5	Low or no voltage at a specific output from DC to DC converter	A. Diode or capacitor in the specific output shorted	Replace components as required.

Figure 3. Malfunction Isolation Chart (2 of 2)



20 volts per centimeter
50 µsec per centimeter

Figure 5. Waveform at Q1 Collector



20 volts per centimeter
.1 millisecond per centimeter

Figure 6. Waveform at Collector of Q9 or Q10

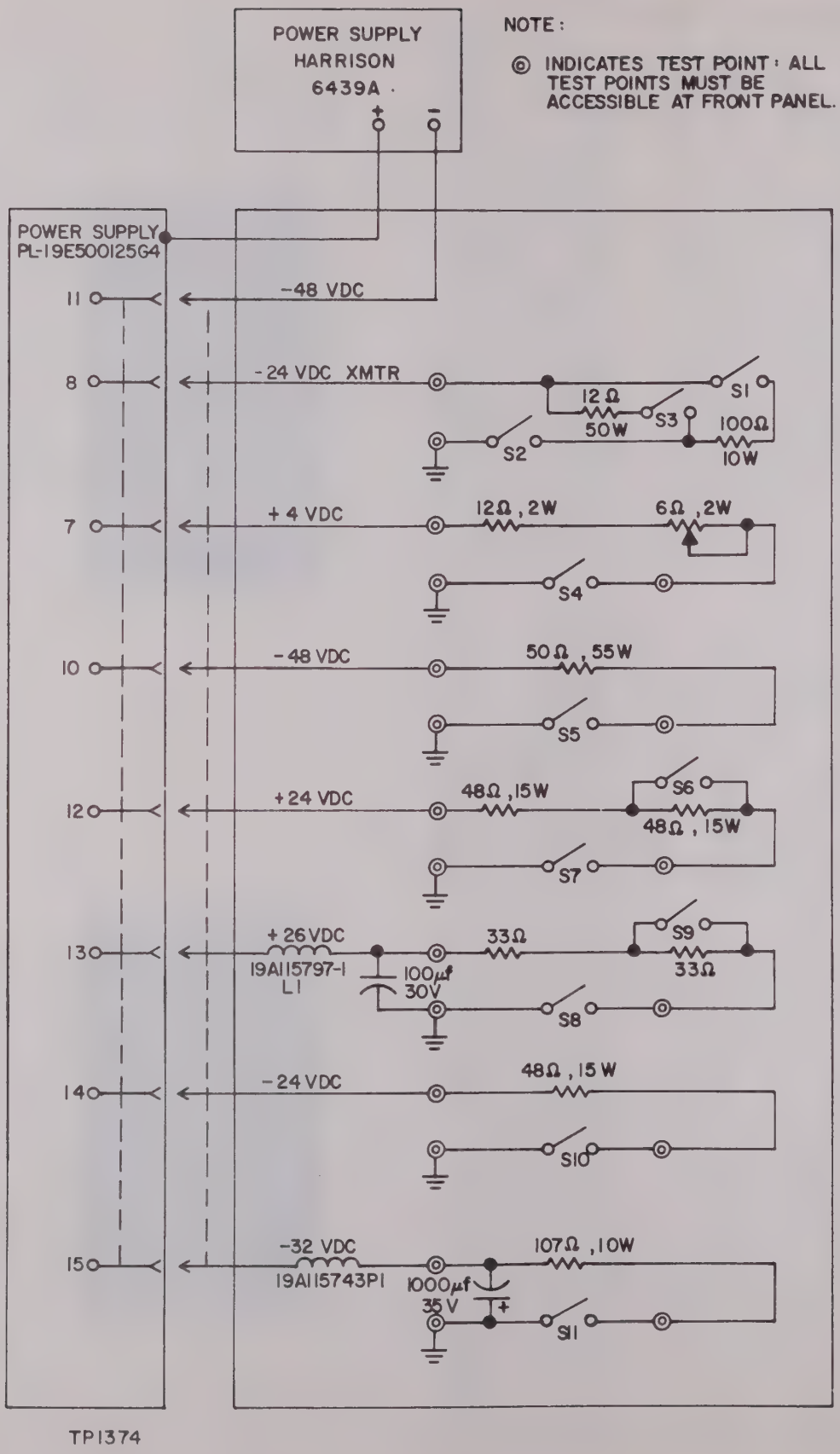


Figure 4. Power Supply Bench Test Setup Diagram

OUTPUT VOLTAGE ADJUSTMENT (CONT)

(3) Close all switches on test setup except S1.

(4) Set all potentiometers in test setup for maximum resistance.

(5) Turn on test setup power supply and set output voltage to -51 Vdc. Assure that current does not exceed 8 amperes. Allow five minutes for power supply to warmup.

(6) Connect oscilloscope to collector of Q1 and adjust R14 for a frequency of 3.1 kHz ±200 Hz (0.32 millisecond per centimeter).

(7) Using multimeter, monitor +26 Vdc and set R28 for +26 ±0.3 Vdc.

(8) Connect multimeter ammeter in series with each load and adjust individual load currents as specified below:

-32 Vdc	290 to 310 mA
+26 Vdc	784 to 816 mA
+ 4 Vdc	240 to 260 mA
-24 Vdc (Rcvr)	480 to 520 mA
+24 Vdc	490 to 510 mA
-24 Vdc (Xmtr)	1.9 to 2.1 A

(9) Using multimeter, monitor all output voltages. Voltages shall be within following limits:

NOTE

Adjust +26 volts to minimize voltage errors at other outputs.

+26 Vdc	+26 ±0.3 Vdc
-32 Vdc	-32 ±0.8 Vdc
-48 Vdc	-49 ±2 Vdc
+ 4 Vdc	+4.4 ±0.3 Vdc
-24 Vdc (Rcvr)	-24 +0.8,-0.5 Vdc
-24 Vdc (Xmtr)	-24 +0.8,-0.5 Vdc
+24 Vdc	+24 +0.8,-0.5 Vdc

SPIKE AND RIPPLE MEASUREMENTS

(1) Using an oscilloscope, monitor the following output voltages. Spike and ripple measurements shall be within the following tolerances:

-24 Vdc (Rcvr)	1 mV ripple 2 mV spike
+24 Vdc	1 mV ripple 2 mV spike
+ 4 Vdc	10 mV ripple 10 mV spike
+26 Vdc	1 mV ripple 2 mV spike
-32 Vdc	1 mV ripple 2 mV spike

CHOPPER REGULATOR FREQUENCY ADJUSTMENT

(1) Connect oscilloscope to collector of Q9, or Q10 and determine operating frequency. Record.

(2) Connect oscilloscope to collector of Q1 and adjust R14 for a frequency 1.8 times that recorded in Step 1.

(3) Use the multimeter to measure the +26 volt output. Adjust R28 for +26 $\pm$0.3 Vdc.

OVERLOAD PROTECTION CIRCUIT CHECKOUT

(1) Close switch S1.

(2) Open and close circuit breaker CB1 five times and assure that it does not kick out.

(3) Place a short across A5-E2 to A5-E3, and then A5-E2 to A5-E1. Circuit breaker should kick out in both cases.

(4) Remove power and disconnect test equipment.

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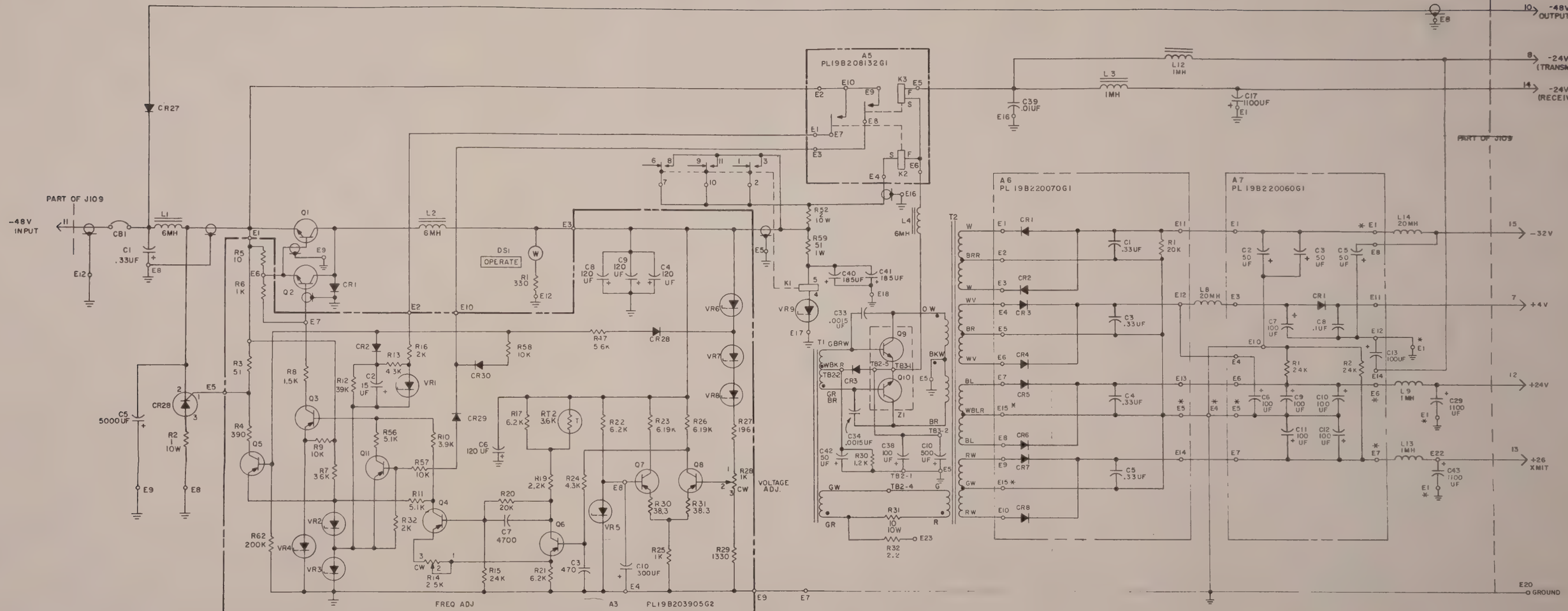


SEMI-CONDUCTOR CHART

ITEM NO	GE INDENT NO	SIMILAR TO** JEDEC REG NO
CR1	19A115890P1	
A3CR2, A3CR28, A3CR30	19A115250P1	SSD-753
CR3, A6CR1– A6CR6, A7CR1	19A115845P1	SC-4
A6CR7 & A6CR8	19A116422P1	SC-4
CR27	19A115202P1	
CR28	19A115814P1	GE C30A
Q1, Q9, Q10	19A115818P1	2N3772
Q2	19A115817P1	
A3Q3, A3Q5	19A115562P1	
A3Q4, A3Q6, A3Q8, A3Q11	19A115768P1	2N3702
A3VR1, A3VR4,	19A115528P8	
A3VR2, A3VR3	19A115528P4	
A3VR5, A3VR8	4036887P5	
VR9	19A115528P2	

** FOR REFERENCE ONLY NOT RECOMMENDED FOR EXACT REPLACEMENT

* DUPLICATED 'E' TERMINALS.

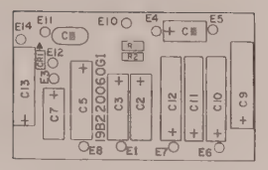
NOTES:
1. ▭ INDICATES FRONT PANEL MARKING
2. SUBASSEMBLY REFERENCE DESIGNATIONS ARE ABBREVIATED. PREFIX THE DESIGNATION WITH SUBASSEMBLY DESIGNATION

ALL RESISTORS ARE 1/2 WATT UNLESS OTHERWISE SPECIFIED AND RESISTOR VALUES IN OHMS UNLESS FOLLOWED BY K=1000 OHMS OR MEG=1,000,000 OHMS. CAPACITOR VALUES IN PICOFARADS (EQUAL TO MICROMICROFARADS) UNLESS FOLLOWED BY UF=MICROFARADS. INDUCTANCE VALUES IN MICROHENRYS UNLESS FOLLOWED BY MH=MILLIHENRYS OR H=HENRYS.

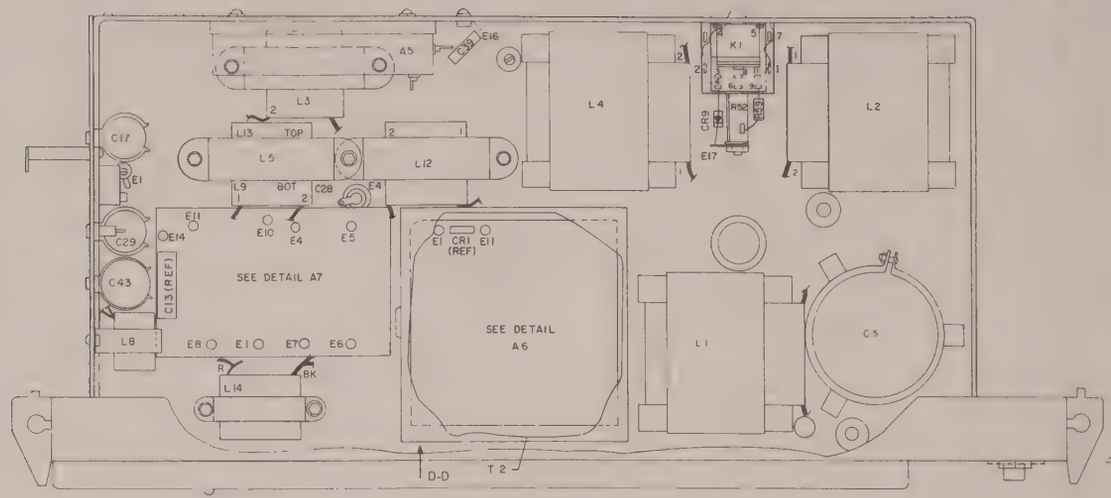
Elementary Diagram

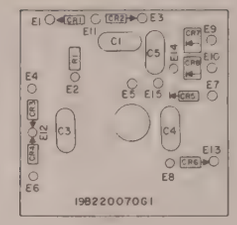
POWER SUPPLY
PL-19E500125-G4

(Drawing No. 19E501320, Rev. 3)

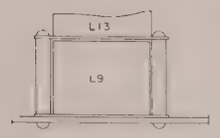


A7

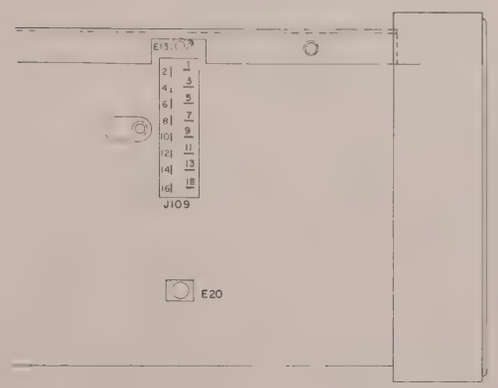


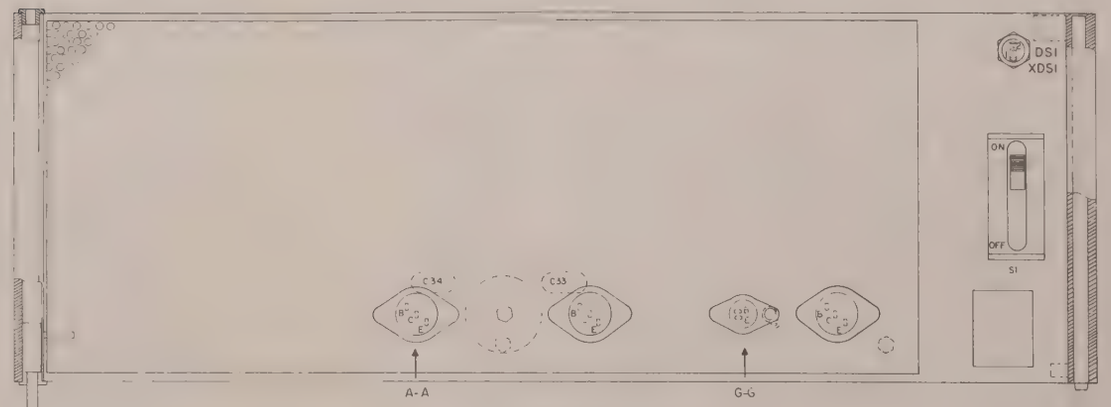


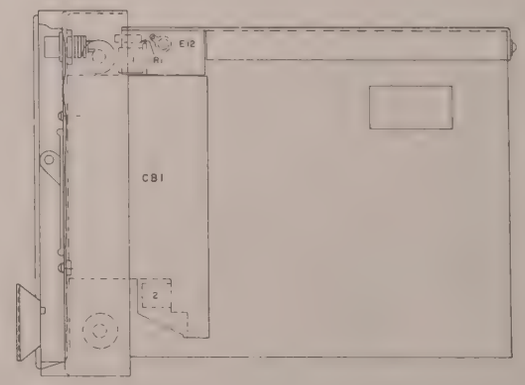
A6

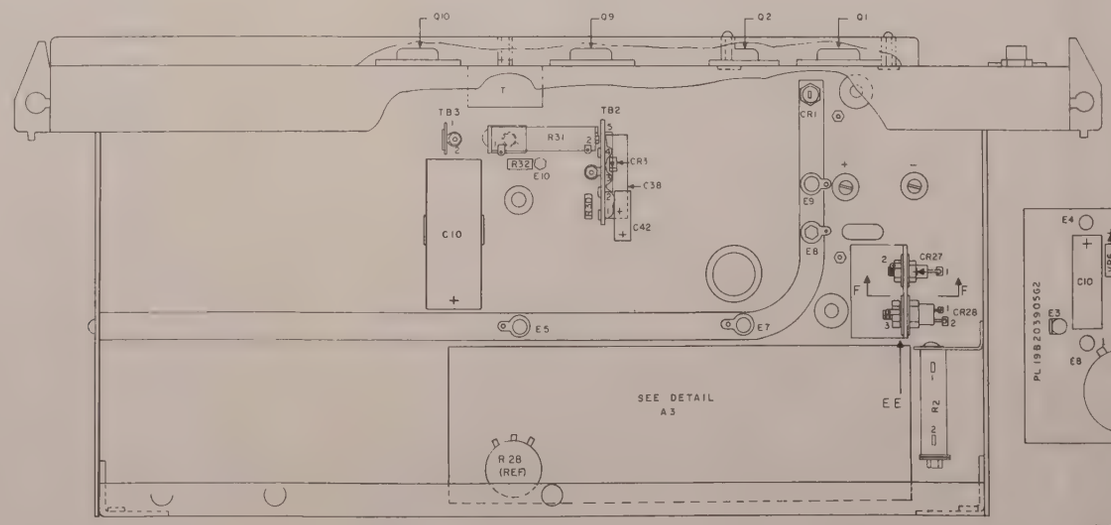


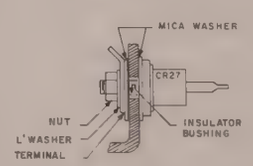
VIEW D-D



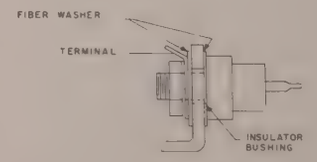






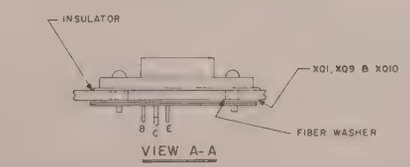


SECTION F-F



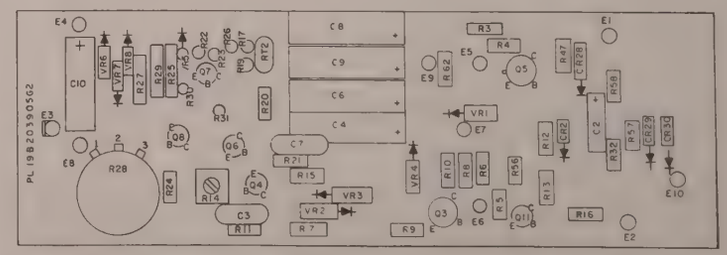
VIEW E-E

MOUNTING FOR Q1, Q9 & Q10

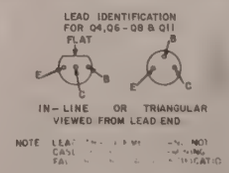


VIEW A-A

VIEW G-G



A3



NOTE LEA... NOT
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Service Outline

POWER SUPPLY UNIT
PL-19E500125-G4

Drawing No. 19E501334, Rev.0

PARTS LIST

POWER SUPPLY
19E500125G4

SYMBOL	GE PART NO.	DESCRIPTION
A3		COMPONENT BOARD 19B203905G2
		- - - - - - - - - CAPACITORS - - - - - - - - - -
C2	5496267P14	Tantalum: 15 µf ±20%, 20 VDCW; sim to Sprague Type 150D.
C3	5496203P466	Ceramic disc: 470 pf ±5%, 500 VDCW, temp coef -5600 PPM.
C4	19A115680P9	Electrolytic: 120 µf +150% -10%, 26 VDCW; sim to Mallory Type TT.
C6	19A115680P9	Electrolytic: 120 µf +150% -10%, 26 VDCW; sim to Mallory Type TT.
C7	7147203P24	Silver mica: 4700 pf ±5%, 300 VDCW; sim to Electro Motive Type DM-20.
C8 and C9	19A115680P9	Electrolytic: 120 µf +150% -10%, 26 VDCW; sim to Mallory Type TT.
C10	19A115680P14	Electrolytic: 300 µf +150% -10%, 7 VDCW; sim to Mallory Type TT.
		- - - - - - - DIODES AND RECTIFIERS - - - - - - -
CR2	19A115250P1	Silicon.
CR28 thru CR30	19A115250P1	Silicon.
		- - - - - - - - - TERMINALS - - - - - - - - - -
E1 thru E10	7135557P1	Terminal: sim to Cinch 13635.
		- - - - - - - - - TRANSISTORS - - - - - - - - -
Q3	19A115562P1	Silicon, PNP.
Q4	19A115768P1	Silicon, PNP.
Q5	19A115562P1	Silicon, PNP.
Q6 thru Q8	19A115768P1	Silicon, PNP.
Q11	19A115768P1	Silicon, PNP.
		- - - - - - - - - - RESISTORS - - - - - - - - -
R3	3R77P510J	Composition: 51 ohms ±5%, 1/2 w.
R4	3R77P391J	Composition: 390 ohms ±5%, 1/2 w.
R5	3R77P100J	Composition: 10 ohms ±5%, 1/2 w.
R6	3R77P102J	Composition: 1000 ohms ±5%, 1/2 w.
R7	3R77P362J	Composition: 3600 ohms ±5%, 1/2 w.
R8	3R77P152J	Composition: 1500 ohms ±5%, 1/2 w.
R9	3R77P103J	Composition: 10,000 ohms ±5%, 1/2 w.
R10	3R77P392J	Composition: 3900 ohms ±5%, 1/2 w.
R11	3R77P512J	Composition: 5100 ohms ±5%, 1/2 w.
R12	3R77P393J	Composition: 39,000 ohms ±5%, 1/2 w.
R13	3R77P432J	Composition: 4300 ohms ±5%, 1/2 w.
R14	19A116559P104	Variable, cermet: 2500 ±20%, 1/2 w; sim to CTS Series 360.
R15	3R77P243J	Composition: 24,000 ohms ±5%, 1/2 w.
R16	3R77P202J	Composition: 2000 ohms ±5%, 1/2 w.
R17	3R77P622J	Composition: 6200 ohms ±5%, 1/2 w.
R20	3R77P203J	Composition: 20,000 ohms ±5%, 1/2 w.
R21 and R22	3R77P622J	Composition: 6200 ohms ±5%, 1/2 w.
R23	5495948P277	Deposited carbon: 6190 ohms ±1%, 1/2 w; sim to Texas Instrument CD1/2MR.
R24	3R77P432J	Composition: 4300 ohms ±5%, 1/2 w.
R25	5495948P201	Deposited carbon: 1000 ohms ±1%, 1/2 w; sim to Texas Instrument CD1/2MR.
R26	5495948P277	Deposited carbon: 6190 ohms ±1%, 1/2 w; sim to Texas Instrument CD1/2MR.
R27	5495948P129	Deposited carbon: 196 ohms ±1%, 1/2 w; sim to Texas Instrument CD1/2MR.
R28	2R73P8	Variable, composition: 1000 ohms ±20%, 2.25 w; sim to Allen-Bradley Type J.
R29	5495948P213	Deposited carbon: 1330 ohms ±1%, 1/2 w; sim to Texas Instrument CD1/2MR.
R30 and R31	19A116278P57	Metal film: 38.3 ohms ±2%, 1/2 w.
R32	3R77P202J	Composition: 2000 ohms ±5%, 1/2 w.
R47	3R77P562J	Composition: 5600 ohms ±5%, 1/2 w.
R56	3R77P512J	Composition: 5100 ohms ±5%, 1/2 w.
R57 and R58	3R77P103J	Composition: 10,000 ohms ±5%, 1/2 w.
R62	3R77P204J	Composition: 0.20 megohms ±5%, 1/2 w.
		- - - - - - - - - THERMISTORS - - - - - - - - -
RT2	5490828P23	Thermistor: 3600 ohms ±10%, color code black; sim to Globar Type 432H-4.
		- - - - - - - - VOLTAGE REGULATORS - - - - - -
VR1	19A115528P8	Silicon, Zener.
VR2 and VR3	19A115528P4	Silicon, Zener.
VR4 thru VR8	4036887P5	Silicon, Zener.
A5	19B208132G1	Relay Box. (Includes E1-E10, K2, K3, TB1).
A6		COMPONENT BOARD 19B220070G1
		- - - - - - - - - - CAPACITORS - - - - - - - - - -
C1	19A116080P110	Polyester: 0.33 µf ±10%, 50 VDCW.
C3 thru C5	19A116080P110	Polyester: 0.33 µf ±10%, 50 VDCW.
		- - - - - - - DIODES AND RECTIFIERS - - - - - - -
CR1 thru CR6	19A115845P1	Silicon.
CR7 and CR8	19A116422P1	Silicon.
		- - - - - - - - - - RESISTORS - - - - - - - - -
R1	3R77P203J	Composition: 20,000 ohms ±5%, 1/2 w.
A7		COMPONENT BOARD 19B220060G1
		- - - - - - - - - CAPACITORS - - - - - - - - - -
C2 and C3	19A115680P11	Electrolytic: 50 µf +150% -10%, 35 VDCW; sim to Mallory Type TT.
C5	19A115680P11	Electrolytic: 50 µf +150% -10%, 35 VDCW; sim to Mallory Type TT.
C6 and C7	7489483P9	Electrolytic: 100 µf +75% -10%, 6 VDCW; sim to Sprague Type 30D.

*COMPONENTS ADDED, DELETED OR CHANGED BY PRODUCTION CHANGES

SYMBOL	GE PART NO.	DESCRIPTION
C8	19A116080P7	Polyester: 0.1 µf ±20%, 50 VDCW.
C9 thru C13	19A115680P12	Electrolytic: 100 µf +150% -10%, 30 VDCW; sim to Mallory Type TT.
		- - - - - - - DIODES AND RECTIFIERS - - - - - - -
CR1	19A115845P1	Silicon.
		- - - - - - - - - - RESISTORS - - - - - - - - - -
R1 and R2	3R77P243J	Composition: 24,000 ohms ±5%, 1/2 w.
		- - - - - - - - - CAPACITORS - - - - - - - - - -
C1	19A115028P17	Polyester: 0.33 µf ±20%, 100 VDCW.
C5	5496520P7	Electrolytic: 5000 µf +100% -10%, 75 VDCW; sim to GE Type 43F.
C10	5493132P7	Electrolytic: 500 µf +150% -10%, 50 VDCW; sim to Sprague D70345.
C17	5493132P13	Electrolytic: 1100 µf +75% -10%, 30 VDCW.
C29	5493132P13	Electrolytic: 1100 µf +75% -10%, 30 VDCW.
C33 and C34	19A115028P1	Polyester: 0.0015 µf ±20%, 200 VDCW.
C38	19A115680P12	Electrolytic: 100 µf +150% -10%, 30 VDCW; sim to Mallory Type TT.
C39	7774750P13	Ceramic disc: 0.01 µf +100% -0%, 500 VDCW.
C40 and C41	19A115680P13	Electrolytic: 185 µf +150% -10%, 21 VDCW; sim to Mallory Type TT.
C42	19A115680P11	Electrolytic: 50 µf +150% -10%, 35 VDCW; sim to Mallory Type TT.
C43	5493132P13	Electrolytic: 1100 µf +75% -10%, 30 VDCW.
		- - - - - - - - - - SWITCHES - - - - - - - - - -
CB1	19B209379P1	Circuit breaker: SPST, 125 VAC, 9 amps; sim to Heinemann X0412-9-125DS-3.
		- - - - - - - DIODES AND RECTIFIERS - - - - - - -
CR1	19A115890P1	Silicon.
CR3	19A115845P1	Silicon.
CR27	19A115202P1	Silicon.
CR28	19A115814P1	Silicon.
		- - - - - - - - INDICATING DEVICES - - - - - - - -
DS1	19A115825P1	Lamp, incandescent: 28 v; sim to Drake 2840.
		- - - - - - - JACKS AND RECEPTACLES - - - - - - -
J109	7775345P48	Connector, phen: 16 contacts; sim to Elco 01-2116-114-004-000.
		- - - - - - - - - - RELAYS - - - - - - - - - -
K1	19B209240P5	Armature, open: 20 VDC nominal, 2 w max operating, 400 ohms ±10% coil res, 3 form C contact; sim to Magnecraft 88X-156.
		- - - - - - - - - - INDUCTORS - - - - - - - - - -
L1 and L2	19A115796P1	Reactor: 6 mh min, 0.1 ohm DC res max, 48 VDC operating.
L3	19A115797P1	Reactor: 1 mh min, 0.1 ohm DC res max, 48 VDC operating.
L4	19A115796P1	Reactor: 6 mh min, 0.1 ohm DC res max, 48 VDC operating.
L8	5490936P2	Choke: .02 h at 0.85 amps DC, 1.3 ohms ±10% DC res.
L9	19A115797P1	Reactor: 1 mh min, 0.1 ohm DC res max, 48 VDC operating.

SYMBOL	GE PART NO.	DESCRIPTION
L12 and L13	19A115797P1	Reactor: 1 mh min, 0.1 ohm DC res max, 48 VDC operating.
L14	19B209345P1	Reactor: 0.20 mh min, 0.5 ohms DC res max, 15 VDC operating.
		- - - - - - - - - TRANSISTORS - - - - - - - - -
Q1	19A115818P1	Silicon, NPN.
Q2	19A115817P1	Silicon, NPN.
Q9 and Q10	19A115818P1	Silicon, NPN.
		- - - - - - - - - - RESISTORS - - - - - - - - - -
R30	3R78P122J	Composition: 1200 ohms ±5%, 1 w.
R31	2R12P11	Wirewound: 10 ohms ±5%, 10 w, includes bracket; sim to Ward Leonard K41382-3.
R32	7147161P29	Composition: 2.2 ohms ±5%, 1/2 w.
R52	2R12P4	Wirewound: 2.0 ohms ±5%, 10 w, includes bracket; sim to Ward Leonard K41382-3.
R59	3R78P510J	Composition: 51 ohms ±5%, 1 w.
		- - - - - - - - - TRANSFORMERS - - - - - - - - -
T1	19A101169G2	Potting, transformer.
T2	19B203912G3	Transformer and can.
		- - - - - - - - TERMINAL BOARDS - - - - - - - - -
TB2	7775500P11	Phen: 5 terminals.
TB3	7775500P45	Phen: 3 terminals.
		- - - - - - - - VOLTAGE REGULATORS - - - - - - - -
VR9	19A115528P2	Silicon, Zener.
		- - - - - - - - - - SOCKETS - - - - - - - - - -
XDS1	19B201122P2	Lampholder: sim to Drake Mfg 121 Series.
XQ1	19B210537P1	Socket, transistor: sim to U.I.D. Electronics Corp PTS-2G.
XQ9 and XQ10	19B210537P1	Socket, transistor: sim to U.I.D. Electronics

PRINCIPLES OF OPERATION

TRS-696 RECEIVER

2.0 GENERAL

2.0.1 The TRS-696 Receiver is designed to receive frequency modulated (FM) signals in the 6-8 GHz range. It is a superheterodyne type of receiver with a solid-state local oscillator that is equipped with automatic frequency control (AFC) and automatic gain control (AGC) loops. The receiver consists of waveguide assemblies, an IF preamplifier, IF pad and equalizer, an IF bandpass filter, an IF amplifier/discriminator, and AFC amplifier, a solid-state local oscillator, a baseband amplifier, a noise comparator, and an (optional) fault sensing unit. These components are housed in a shelf with a swing-out door. The IF amplifier/discriminator, baseband amplifier, sensing unit, AFC amplifier and local oscillator controls are mounted on the door assembly. The local oscillator, IF pad and equalizer, IF bandpass filter and the waveguide assemblies are mounted on the shelf.

2.1 SPECIFICATIONS

Frequency:

Common Carrier Band:	5925 to 6425 MHz
PSIT Band:	6575 to 6875 MHz
Government Band:	7125 to 8400 MHz
IF Frequency:	70 MHz
IF Bandwidth (3 dB):	
Common Carrier and Government Band:	15 MHz for up to and including 420 channels
	25 MHz for more than 420 channels
PSIT Band:	15 MHz for all channel loading
Noise Figure:	10 dB maximum without isoduplexer 10.4 dB maximum with isoduplexer

Sensitivity:

Common Carrier Band

960 channels; with emphasis; 25 MHz IF:	-76 dBm
600 channels; with emphasis; 25 MHz IF:	-80 dBm
420 channels; with emphasis; 15 MHz IF:	-83 dBm
300 channels; no emphasis; 15 MHz IF:	-83 dBm

PSIT Band

600 channels; with emphasis; 15 MHz IF: -76 dBm
420 channels; with emphasis; 15 MHz IF: -83 dBm

IF Carrier Stability with AFC:	±500 kHz
Squelch Level:	Set to initiate at S/N of 32.5 dBp in worst slot
Squelch - Unsquelch Differential:	5 dB typical
Receiver AGC Range:	50 dB
Supply Voltages:	-24 Vdc +24 Vdc

2.2 CONTROLS, INDICATORS AND TEST POINTS

2.2.1 METER SELECTOR: The meter selector switch is located on front of the receiver door. It switches the rack meter (located on the meter panel in a Basic Rack and on the Diversity Controller in the Expandable and Diversity Racks) into six circuits to monitor functions bearing on receiver operation. The functions monitored are:

(1) -24 VDC
(2) +24 VDC
(3) AFC
(4) AGC
(5) MIXER CURRENT
(6) PILOT LEVEL

2.2.2 FAULT LIGHT: The fault light is located on front of the receiver door. It is controlled by the sensing unit which monitors mixer current and continuity pilot level. Should either of these two functions drop below a present level, the light is turned on to indicate the presence of a fault.

2.2.3 SQUELCH LIGHT: The squelch light is located on front of the receiver door. It is controlled by the sensing unit, and is turned on when the receiver is squelched.

2.2.4 AFC CONTROL PANEL: Four controls and a pair of test points for the AFC loop are located on back of the receiver door. The controls are as follows: (1) a four-position AFC switch, (2) an L.O. FREQUENCY ADJUST control, (3) a BALANCE ADJUST control, and (4) an AFC BIAS ADJUST control; the pair of test points are marked BALANCE. In addition to controlling the AFC amplifier circuit, the four-position AFC switch is connected to the selector switch on the receiver door. When the selector switch is in its AFC position, the rack meter is connected into the circuit to monitor AFC operation and to aid in the adjustment of the AFC loop.

2.2.5 FADE SIMULATOR: The fade simulator (optional in the Common Carrier Basic Rack and in all PSIT Rack configurations) is a part of the receiver waveguide run located on the receiver shelf. Up to 50 dB of attenuation, calibrated in 5 dB increments, can be inserted to simulate a fade by turning the spring-loaded control. When the control is released, it returns to the 0 dB position.

2.2.6 LOCAL OSCILLATOR: A voltage test point, an adjustment control and a signal test jack are located on the local oscillator. The local oscillator operating voltage is set to -20 Vdc by connecting a meter from TP1 to ground and turning the L.O. VOLT ADJ control. The MOD INPUT test jack is used in receiver adjustment procedures.

2.3 FUNCTIONAL DESCRIPTION

2.3.0.1 The functional description of the receiver is given in four parts: (1) signal circuit, (2) AFC circuit, (3) fault sensing, and (4) metering circuit.

2.3.1 SIGNAL CIRCUIT

2.3.1.1 Refer to Drawing 19D410705, Sheet 2. Incoming signal from the waveguide stack enters the receiver through a seven-section waveguide preselector filter having a nominal bandpass of 37 MHz. It then passes through an isolator section that is oriented so it offers 0.5 dB or less attenuation to signal moving into the receiver but 20 dB or more of attenuation to signal moving away from the receiver. The signal then enters the fade simulator. The fade simulator (an option in the Common Carrier Basic Rack and in all PSIT Rack configurations) provides the means for inserting up to 50 dB of attenuation in series with the incoming signal to simulate a fade for test purposes. The signal then enters the mixer section.

2.3.1.2 The incoming signal is mixed with the output of the local oscillator to produce a 70 MHz IF signal in mixer diode CR1. The local oscillator signal, which can be either 70 MHz above or below the frequency of the incoming signal, is connected to the mixer at jack J2. The resultant 70 MHz IF signal is applied to the IF preamplifier at terminal E1. The preamplifier, which is part of the mixer assembly, is a five-stage amplifier with low input noise figure. Its principal function is to raise the IF signal to an adequate level so the loss incurred in the IF filter and IF pad and equalizer that follow will not alter noise figure. It also supplies a dc voltage proportional to mixer current to the metering and sensing circuits through C1-A, J14-D and J101-F. The IF output of the preamplifier is taken at jack J3.

2.3.1.3 Signal from the preamplifier is passed through an IF equalizer and pad and an IF bandpass filter to the IF amplifier. The equalizer provides both parabolic and slope delay equalization.

2.3.1.4 Signal enters the IF amplifier at J16. The amplifier circuit includes a detector that provides an AGC voltage which is applied to six of the amplifier stages to control overall gain in

accordance with received carrier level. This voltage is also made available to the metering circuit through terminal C1-A. The output of the IF amplifier is applied to limiter CR1-CR2-R2 through C6. Limiter output is amplified and applied to the discriminator (CR3-CR4). Discriminator output is applied to the AFC amplifier through R57-E17 and E24, and to the baseband amplifier through E16 and E25.

2.3.1.5 Signal from the discriminator is applied to the baseband amplifier at E26. This unit contains a four-stage amplifier circuit and squelch relay K1. The output of the third stage is connected through the normally closed contacts of K1 to baseband output terminal E34 through R21. Relay K1 is energized to squelch the receiver. Baseband output terminal E34 is then grounded through resistor R21 and the contacts on relay K1. The output of the fourth stage is applied to the noise comparator unit through R19 and E29, to the sensing unit through R17 and E28, and to OUTPUT MONITOR jack J20 through R18 and E32.

2.3.1.6 The noise comparator units operate in pairs, one in each receiver door. The noise level in each receiver is detected and converted to a dc voltage. Comparison of the dc voltages in each unit is made through a cross-connected AGC network. The noise sample input from the baseband amplifier is applied through selective filter, FL1 to the input of the noise amplifier at E1. The SQUELCH ADJ control R1 sets the input noise level at which the squelch gate will trip. The continuously variable attenuator (in each unit) are AGC cross-connected so that the unit with the greater input controls the gain of both units or if both input levels are equal, they share control equally. The output of the noise amplifier is fed to the squelch circuit and to the noise fault circuit. In the squelch circuit, the noise is detected and applied through a level detector to provide the squelch gate input to the sensing unit through A2E1-2B. The noise fault circuit input is buffered and detected and fed to one side of the differential amplifier. The detected output (NOISE COMP IN) from the second comparator is fed to the other side of the differential amplifier. The output of the differential amplifier is applied to a Schmitt trigger level detector. The NOISE FAULT ADJ control R56 provides for setting the input noise difference at which the Schmitt trigger will trip. The regenerative level detector stage of the squelch circuit provides a squelch gate output when the noise level exceeds the limit set by R1. When the noise difference exceeds the level set by R56, the Schmitt trigger of the noise circuit provides a noise fault output. The Schmitt trigger output also drives a switch circuit for fault alarm and fault relay operation.

2.3.2 AFC CIRCUIT

2.3.2.1 The AFC circuit can be traced from terminal E24 on the discriminator to terminal E46 on the AFC amplifier, and from terminal E48 on the amplifier through J101-H to J13-B on the local oscillator. The AFC amplifier consists of a difference amplifier, a reference voltage source and a switching circuit.

2.3.2.2 Signal from the discriminator is compared to the reference voltage by the difference amplifier. The output of the amplifier is a voltage proportional to the difference between the discriminator signal and the reference voltage. This voltage is used to tune the local oscillator so a constant 70 MHz difference between it and the incoming signal frequency will be maintained. The switching circuit provides the means to turn the AFC on and off, and to monitor the function of the AFC circuit during adjustment and operation. It is connected to the metering circuit at terminals E76 and E77.

2.3.3 FAULT SENSING

2.3.3.1 Receiver fault sensing is accomplished by the receiver fault sensing unit. This unit (optional in the Basic Rack configuration) monitors mixer current, continuity pilot and squelch. Its several outputs serve four basic functions: (1) to indicate a receiver fault if mixer current or pilot drop below a preset level, (2) to provide a dc voltage proportional to pilot level to the metering circuit, (3) to provide a pilot fault gate to the Diversity Controller when pilot signal drops below a preset level or when the receiver is squelched, and (4) to operate squelch alarm indicators when the receiver is squelched.

2.3.3.2 The mixer current input is applied to the unit at J22-K. It is amplified, detected and connected to the input of a Schmitt trigger level detector.

2.3.3.3 Pilot signal from the baseband amplifier is applied to the unit at J22-R. It is amplified by an amplifier tuned to the pilot signal frequency and applied to two detectors. The output of one detector is a dc voltage proportional to pilot level that is connected to the metering circuit through J22-L. The output of the second detector is connected to the pilot level detector which in turn furnishes one of the two inputs to the pilot logic circuit. Squelch signal applied to J22-F is the second input to the logic circuit. The logic circuit provides the pilot fault output (J22-B) of the unit, and is connected into the same level detector to which the mixer current circuit is connected. The logic circuit will provide the necessary input to the level detector to declare a receiver fault due to pilot degradation or failure when the receiver is not squelched, but will block this input so a receiver fault based on pilot level will not be indicated when the receiver is squelched; it also provides a pilot fault output based on pilot level when the receiver is not squelched, and assures a pilot fault output when the receiver is squelched.

2.3.3.4 A receiver fault is indicated when the level detector to which both the mixer current detector and the pilot logic circuit are connected is caused to switch. It will switch when mixer current or pilot level drops (provided the receiver is not squelched) below a preset level. Its output is used to operate the fault light on the receiver door (J22-A) and a fault relay (J22-C). The unit contains a squelch voltage amplifier which provides a voltage to operate the squelch light on the receiver door (J22-D), and to operate a squelch alarm relay (J22-E).

2.3.4 METERING CIRCUIT

2.3.4.1 Six functions bearing on receiver operation can be monitored by the metering system built into the rack. The meter is located on the meter panel in a Basic Rack, and on the Diversity Controller in an Expandable or Diversity Rack. When its selector switch has been set to the REC position, the meter is connected to selector switch S1 on the receiver door. A description of the circuit for each function follows. Refer to Drawing 19D410706.

2.3.4.2 -24 VDC (position 1): The meter is connected to the -24 volt source through S1A-1 and R2, and to ground through S1A-7. The normal meter reading is red line ±3 small divisions.

2.3.4.3 +24 VDC (position 2): The meter is connected to the +24 volt source through S1A-8 and R4, and to ground through S1A-2. The normal meter reading is red line ±3 small divisions.

2.3.4.4 AFC (position 3): When the selector switch is in this position, the meter is connected across a four-position selector switch located on the AFC control panel. The circuit can be traced from S1A-3 and 9 to terminals E77 and E76 respectively. Note that when the selector switch on the receiver door is not in the AFC position, resistor R7 is connected across terminals E77 and E76 through S1B. A description of the circuit for each position of the selector switch on the AFC control panel follows.

2.3.4.4.1 METER ZERO: The meter is connected across R2 and R3 through S1A-1, S1B-1 and S1A-7; resistors R2 and R3 are part of a series-parallel network formed by R1, R2, R3, R8, R9, R11 and R14 that is connected to the -24 volt source on one side and to the +21 volt source on the other. The AFC loop is open and the input to the AFC amplifier is grounded through S1B-7 and R7. METER ZERO control R1 is adjusted to obtain a reading of zero on the bottom scale.

2.3.4.4.2 OFF: The meter is connected to the -24 volt source through S1A-2, R1 and R11; to the +21 volt source at the divider formed by R14 and R9 through S1A-8; and to the AFC error signal through E46, R6 and S1B-2. The AFC loop is open and the input to the AFC amplifier is grounded through S1B-8 and R7. The meter indicates relative frequency; zero on the bottom scale represents the on-frequency condition.

2.3.4.4.3 RANGE: The meter is connected to ground through S1A-9, and to AFC output terminal E48 through R36 and R37 and S1A-3. The AFC loop is open and the input of the AFC amplifier is grounded through S1B-9 and R7. This position provides the metering needed to set AFC output in the center of its range. Since the range of voltage at E48 exceeds the range of the meter, resistors R38-R39 and diode CR1 serve to limit the voltage applied to the meter.

2.3.4.4.4 ON: The meter is connected to the -24 volt source through S1A-4, R1 and R11; to the +21 volt source at the divider formed by R14 and R9 through S1A-10; and to the AFC error signal through E46,

R5 and S1B-4. The AFC loop is closed and the error signal at E46 is applied to the input of the AFC amplifier through S1B-10. THIS IS THE NORMAL POSITION OF THE SELECTOR SWITCH ON THE AFC CONTROL PANEL. In this position the meter indicates relative frequency, and the meter should indicate to zero on the bottom scale when AFC is operating.

2.3.4.5 AGC (position 4): When the selector switch on the receiver door is in this position, the meter is connected to the AGC voltage at C1-A on the IF amplifier/discriminator through S1A-4 and R1, and to ground through S1A-10. The meter will read up-scale by an amount inversely proportional to carrier level. A linear dB calibration of the meter scale can be made by using the fade simulator (or some other calibrated means of attenuating the carrier) when the meter is switched into this circuit.

2.3.4.6 MIXER CURRENT (position 5): The meter is connected to terminal C1-A on the IF preamplifier through S1A-11, R3, 101-F and J14-D, and to ground through S1A-5. After adjustment procedures have been completed, local oscillator injection is adjusted to obtain a red line meter reading.

2.3.4.7 PILOT (position 6): The meter is connected to the output of a pilot detector in the sensing unit at terminal J22-L through S1A-6, and to ground through S1A-12. After adjustment procedures have been completed the output of the pilot detector is adjusted to obtain a red line meter reading.

TELECOMMUNICATION PRODUCTS DEPARTMENT
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PARTS LIST

IF AMPLIFIER/DISCRIMINATOR
19D405379-G1 and G2

SYMBOL	G-E PART NO.	DESCRIPTION
A1		IF AMPLIFIER BOARD A1 19C306612-G1 (Used in 19D405379-G1) A1 19C306612-G2 (Used in 19D405379-G2)
		- - - - - - - - - - CAPACITORS - - - - - - - - - -
C1	5490446-P6	Variable, ceramic: approx 5-30 pf, 350 VDCW, temp coef -750 PPM; sim to Erie Style 557-36.
C2 thru C28	7491827-P2	Ceramic disc: .01 µf +80% -30%, 50 VDCW; sim to Sprague 19C180.
C30 thru C42	7491827-P2	Ceramic disc: .01 µf +80% -30%, 50 VDCW; sim to Sprague 19C180.
C43	5490446-P2	Variable, ceramic: approx 5-25 pf, 350 VDCW, temp coef 0 PPM; sim to Erie Style 557-36.
C44	5490008-P143	Silver mica: 470 pf ±10%, 300 VDCW; sim to Electro Motive Type DM-15.
C45 and C46	7491827-P2	Ceramic disc: .01 µf +80% -30%, 50 VDCW; sim to Sprague 19C180.
C47 and C48	5490008-P143	Silver mica: 470 pf ±10%, 300 VDCW; sim to Electro Motive Type DM-15.
C49	19A115680-P10	Electrolytic: 200 µf +150% -10%, 18 VDCW; sim to Mallory Type TT.
C50	7489483-P11	Electrolytic: 20 µf +75% -10%, 50 VDCW; sim to Sprague 30D.
C51	5490008-P143	Silver mica: 470 pf ±10%, 300 VDCW; sim to Electro Motive Type DM-15.
C52	7491827-P2	Ceramic disc: .01 µf +80% -30%, 50 VDCW; sim to Sprague 19C180.
C53	19A115680-P11	Electrolytic: 50 µf +150% -10%, 35 VDCW; sim to Mallory Type TT.
		- - - - - - - DIODES AND RECTIFIERS - - - - - - -
CR1 thru CR6	19A115754-P1	Silicon.
CR7 and CR8	19A115059-P1	Germanium.
CR11	4037822-P1	Silicon.
CR12	19A115250-P1	Silicon.
		- - - - - - - - - - TERMINALS - - - - - - - - - -
E1 thru E9	19A115296-P1	Terminal, stud.
		- - - - - - - - - - INDUCTORS - - - - - - - - - -
L1 thru L9	7488079-P10	Choke, RF: 3.30 µh ±10%, 0.15 ohms DC res max; sim to Jeffers 4421-1.
L11 thru L15	7488079-P10	Choke, RF: 3.30 µh ±10%, 0.15 ohms DC res max; sim to Jeffers 4421-1.
L16	7491382-P101	Coil, RF: 100 µh ±10%, 4 ohms DC res max; sim to Delevan 3500 Series.
L17 and L18	7488079-P10	Choke, RF: 3.30 µh ±10%, 0.15 ohms DC res max; sim to Jeffers 4421-1.
L19	19B203468-G9	Coil.
L20	19B203468-G7	Coil.

SYMBOL	G-E PART NO	DESCRIPTION
		- - - - - - - - - - TRANSISTORS - - - - - - - - - -
Q1 thru Q10	19A115440-P1	Silicon, NPN.
Q11	19A115329-P1	Silicon, NPN.
Q12 thru Q14	19A115889-P1	Silicon, NPN.
Q15	19A115562-P2	Silicon, PNP.
Q16	19A115300-P2	Silicon, NPN.
		- - - - - - - - - - RESISTORS - - - - - - - - - -
R1	19B209294-P65	Metal film: 46.4 ohms ±1%, 1/8 w; sim to IRC Type CEA-TO.
R2	3R152-P201J	Composition: 200 ohms ±5%, 1/4 w.
R3	3R152-P222J	Composition: 2200 ohms ±5%, 1/4 w.
R4	3R152-P103J	Composition: 10,000 ohms ±5%, 1/4 w.
R5	3R152-P682J	Composition: 6800 ohms ±5%, 1/4 w.
R6	3R152-P911J	Composition: 910 ohms ±5%, 1/4 w.
R7	3R152-P910J	Composition: 91 ohms ±5%, 1/4 w.
R8	3R77-P242J	Composition: 2400 ohms ±5%, 1/2 w.
R9	3R152-P201J	Composition: 200 ohms ±5%, 1/4 w.
R10	3R152-P222J	Composition: 2200 ohms ±5%, 1/4 w.
R11	3R152-P103J	Composition: 10,000 ohms ±5%, 1/4 w.
R12	3R152-P682J	Composition: 6800 ohms ±5%, 1/4 w.
R13	3R152-P911J	Composition: 910 ohms ±5%, 1/4 w.
R14	3R152-P910J	Composition: 91 ohms ±5%, 1/4 w.
R15	3R77-P242J	Composition: 2400 ohms ±5%, 1/2 w.
R16	3R152-P201J	Composition: 200 ohms ±5%, 1/4 w.
R17	3R152-P222J	Composition: 2200 ohms ±5%, 1/4 w.
R18	3R152-P103J	Composition: 10,000 ohms ±5%, 1/4 w.
R19	3R152-P682J	Composition: 6800 ohms ±5%, 1/4 w.
R20	3R152-P911J	Composition: 910 ohms ±5%, 1/4 w.
R21	3R152-P910J	Composition: 91 ohms ±5%, 1/4 w.
R22	3R77-P242J	Composition: 2400 ohms ±5%, 1/2 w.
R23	3R152-P201J	Composition: 200 ohms ±5%, 1/4 w.
R24	3R152-P222J	Composition: 2200 ohms ±5%, 1/4 w.
R25	3R152-P103J	Composition: 10,000 ohms ±5%, 1/4 w.
R26	3R152-P682J	Composition: 6800 ohms ±5%, 1/4 w.
R27	3R152-P911J	Composition: 910 ohms ±5%, 1/4 w.
R28	3R152-P910J	Composition: 91 ohms ±5%, 1/4 w.
R29	3R77-P242J	Composition: 2400 ohms ±5%, 1/2 w.
R30	3R152-P201J	Composition: 200 ohms ±5%, 1/4 w.
R31	3R152-P222J	Composition: 2200 ohms ±5%, 1/4 w.
R32	3R152-P103J	Composition: 10,000 ohms ±5%, 1/4 w.
R33	3R152-P682J	Composition: 6800 ohms ±5%, 1/4 w.
R34	3R152-P911J	Composition: 910 ohms ±5%, 1/4 w.
R35	3R152-P910J	Composition: 91 ohms ±5%, 1/4 w.
R36	3R77-P242J	Composition: 2400 ohms ±5%, 1/2 w.
R37	3R152-P201J	Composition: 200 ohms ±5%, 1/4 w.
R38	3R152-P222J	Composition: 2200 ohms ±5%, 1/4 w.
R39	3R152-P103J	Composition: 10,000 ohms ±5%, 1/4 w.
R40	3R152-P682J	Composition: 6800 ohms ±5%, 1/4 w.
R41	3R152-P911J	Composition: 910 ohms ±5%, 1/4 w.
R42	3R152-P910J	Composition: 91 ohms ±5%, 1/4 w.
R43	3R77-P242J	Composition: 2400 ohms ±5%, 1/2 w.

*COMPONENTS ADDED DELETED OR CHANGED BY PRODUCTION CHANGES.

SYMBOL	G-E PART NO	DESCRIPTION
R44	3R152-P201J	Composition: 200 ohms ±5%, 1/4 w.
R45	3R152-P222J	Composition: 2200 ohms ±5%, 1/4 w.
R46	3R152-P103J	Composition: 10,000 ohms ±5%, 1/4 w.
R47	3R152-P682J	Composition: 6800 ohms ±5%, 1/4 w.
R48	3R152-P911J	Composition: 910 ohms ±5%, 1/4 w.
R49	3R152-P430J	Composition: 43 ohms ±5%, 1/4 w.
R50	3R152-P201J	Composition: 200 ohms ±5%, 1/4 w.
R51	3R152-P222J	Composition: 2200 ohms ±5%, 1/4 w.
R52	3R152-P103J	Composition: 10,000 ohms ±5%, 1/4 w.
R53	3R152-P682J	Composition: 6800 ohms ±5%, 1/4 w.
R54	3R152-P911J	Composition: 910 ohms ±5%, 1/4 w.
		NOTE The value of R55 must be obtained from the component, then find corresponding value in parts list for the correct part number.
R55	3R152-P240J	Composition: 24 ohms ±5%, 1/4 w.
R55	3R152-P270J	Composition: 27 ohms ±5%, 1/4 w.
R55	3R152-P300J	Composition: 30 ohms ±5%, 1/4 w.
R55	3R152-P330J	Composition: 33 ohms ±5%, 1/4 w.
R55	3R152-P360J	Composition: 36 ohms ±5%, 1/4 w.
R55	3R152-P390J	Composition: 39 ohms ±5%, 1/4 w.
R55	3R152-P430J	Composition: 43 ohms ±5%, 1/4 w.
R55	3R152-P470J	Composition: 47 ohms ±5%, 1/4 w.
R55	3R152-P510J	Composition: 51 ohms ±5%, 1/4 w.
R56	3R152-P101J	Composition: 100 ohms ±5%, 1/4 w.
R57	3R152-P222J	Composition: 2200 ohms ±5%, 1/4 w.
R58	3R152-P103J	Composition: 10,000 ohms ±5%, 1/4 w.
R59	3R152-P682J	Composition: 6800 ohms ±5%, 1/4 w.
R60	3R152-P222J	Composition: 2200 ohms ±5%, 1/4 w.
R61	3R152-P103J	Composition: 10,000 ohms ±5%, 1/4 w.
R62	3R152-P682J	Composition: 6800 ohms ±5%, 1/4 w.
R63	3R152-P911J	Composition: 910 ohms ±5%, 1/4 w.
R64	3R152-P270J	Composition: 27 ohms ±5%, 1/4 w.
R65	3R152-P101J	Composition: 100 ohms ±5%, 1/4 w.
R66	3R77-P511J	Composition: 510 ohms ±5%, 1/2 w.
R67	3R152-P182J	Composition: 1800 ohms ±5%, 1/4 w.
R68	3R152-P202J	Composition: 2000 ohms ±5%, 1/4 w.
R69	3R152-P391J	Composition: 390 ohms ±5%, 1/4 w.
R70	3R77-P152J	Composition: 1500 ohms ±5%, 1/2 w.
R71	3R152-P101J	Composition: 100 ohms ±5%, 1/4 w.
R72 and R73	3R152-P201J	Composition: 200 ohms ±5%, 1/4 w.
R74	5492251-P102	Variable, composition: 100 ohms ±10%, 0.25 w; sim to Allen-Bradley Type F.
R75 and R76	3R152-P622J	Composition: 6200 ohms ±5%, 1/4 w.
R77	3R152-P332J	Composition: 3300 ohms ±5%, 1/4 w.
R78	3R152-P432J	Composition: 4300 ohms ±5%, 1/4 w.
R79 and R80	3R152-P152J	Composition: 1500 ohms ±5%, 1/4 w.
R81	3R152-P102J	Composition: 1000 ohms ±5%, 1/4 w.
R82	3R152-P911J	Composition: 910 ohms ±5%, 1/4 w.
R83	5495948-P141	Deposited carbon: 261 ohms ±1%, 1/2 w; sim to Texas Instrument CD1/2MR.
R84	3R152-P512J	Composition: 5100 ohms ±5%, 1/4 w.

SYMBOL	G-E PART NO	DESCRIPTION
R85	3R152-P362J	Composition: 3600 ohms ±5%, 1/4 w.
R87	3R152-P101J	Composition: 100 ohms ±5%, 1/4 w.
R88	3R152-P221J	Composition: 220 ohms ±5%, 1/4 w.
R89	3R152-P151J	Composition: 150 ohms ±5%, 1/4 w.
R90	3R152-P390J	Composition: 39 ohms ±5%, 1/4 w. (Used in G1 only).
		- - - - - - - - - TRANSFORMERS - - - - - - - - -
T1 thru T19	19A101377-G2	Coil.
T20	19A101883-G1	Coil.
		- - - - - - - - VOLTAGE REGULATORS - - - - - - - -
VR1 and VR2	4036887-P5	Silicon, Zener.
A2		DISCRIMINATOR BOARD ASSEMBLY 19B208562-G1
		- - - - - - - - - - CAPACITORS - - - - - - - - - -
C1	7491827-P2	Ceramic disc: .01 µf +80% -30%, 50 VDCW; sim to Sprague 19C180.
C2 and C3	7489162-P43	Silver mica: 470 pf ±5%, 300 VDCW; sim to Electro Motive Type DM-15.
C4	7489162-P35	Silver mica: 220 pf ±5%, 300 VDCW; sim to Electro Motive Type DM-15.
C5 thru C14	7491827-P2	Ceramic disc: .01 µf +80% -30%, 50 VDCW; sim to Sprague 19C180.
C15	7489162-P33	Silver mica: 180 pf ±5%, 300 VDCW; sim to Electro Motive Type DM-15.
C16 and C17	7491827-P2	Ceramic disc: .01 µf +80% -30%, 50 VDCW; sim to Sprague 19C180.
C18	7489162-P43	Silver mica: 470 pf ±5%, 300 VDCW; sim to Electro Motive Type DM-15.
C19 and C20	7491827-P2	Ceramic disc: .01 µf +80% -30%, 50 VDCW; sim to Sprague 19C180.
C21	5490446-P2	Variable, ceramic: approx 5-25 pf, 350 VDCW, temp coef 0 PPM; sim to Erie Style 557-36.
C22	7489162-P35	Silver mica: 220 pf ±5%, 500 VDCW; sim to Electro Motive Type DM-15.
C23	7489162-P43	Silver mica: 470 pf ±5%, 300 VDCW; sim to Electro Motive Type DM-15.
C24	7491827-P2	Ceramic disc: .01 µf +80% -30%, 50 VDCW; sim to Sprague 19C180.
C25	7489162-P35	Silver mica: 220 pf ±5%, 500 VDCW; sim to Electro Motive Type DM-15.
C26	7489162-P43	Silver mica: 470 pf ±5%, 300 VDCW; sim to Electro Motive Type DM-15.
C27	7491827-P2	Ceramic disc: .01 µf +80% -30%, 50 VDCW; sim to Sprague 19C180.
C28 and C29	5490446-P2	Variable, ceramic: approx 5-25 pf, 350 VDCW, temp coef 0 PPM; sim to Erie Style 557-36.
C30	7491827-P2	Ceramic disc: .01 µf +80% -30%, 50 VDCW; sim to Sprague 19C180.
C31 and C32	7489162-P6	Silver mica: 10 pf ±0.5 pf, 500 VDCW; sim to Electro Motive Type DM-15.
C33	7489162-P3	Silver mica: 7 pf ±0.5 pf, 500 VDCW; sim to Electro Motive Type DM-15.
C34 and C35	7489162-P43	Silver mica: 470 pf ±5%, 300 VDCW; sim to Electro Motive Type DM-15.
C36	7491827-P2	Ceramic disc: .01 µf +80% -30%, 50 VDCW; sim to Sprague 19C180.
		- - - - - - - DIODES AND RECTIFIERS - - - - - - -
CR1 and CR2	19A116052-P1	Silicon.
CR3 and CR4		(Part of Z1).

SYMBOL	G-E PART NO	DESCRIPTION
		- - - - - - - - - - TERMINALS - - - - - - - - - -
E11 thru E17	19A115296-P1	Terminal, stud.
		- - - - - - - JACKS AND RECEPTACLES - - - - - - -
J17 and J18	7776570-P17	Receptacle, bulkhead: coaxial, 500 v peak. Military Type UG-1094/U.
		- - - - - - - - - - INDUCTORS - - - - - - - - - -
L1	19B203468-G11	Coil.
L2	19B203468-G12	Coil.
L3	19B203468-G11	Coil.
L4	7488079-P37	Choke, RF: 3.30 µh ±10%, 1.40 ohms DC res max; sim to Jeffers 4412-11.
		- - - - - - - - - - TRANSISTORS - - - - - - - - - -
Q1	19A115440-P1	Silicon, NPN.
Q2 thru Q4	19A115810-P1	Silicon, NPN.
Q5 and Q6	19A115440-P1	Silicon, NPN.
Q7 and Q8	19A115810-P1	Silicon, NPN.
		- - - - - - - - - - RESISTORS - - - - - - - - - -
R1	3R152-P391J	Composition: 390 ohms ±5%, 1/4 w.
R2 and R3	3R152-P102J	Composition: 1000 ohms ±5%, 1/4 w.
R4	3R152-P122J	Composition: 1200 ohms ±5%, 1/4 w.
R5 and R6	3R152-P910J	Composition: 91 ohms ±5%, 1/4 w.
R7	3R152-P152J	Composition: 1500 ohms ±5%, 1/4 w.
R9	3R152-P152J	Composition: 1500 ohms ±5%, 1/4 w.
R10 and R11	3R152-P103J	Composition: 10,000 ohms ±5%, 1/4 w.
R12	3R152-P682J	Composition: 6800 ohms ±5%, 1/4 w.
R13	3R152-P100J	Composition: 10 ohms ±5%, 1/4 w.
R14	3R152-P682J	Composition: 6800 ohms ±5%, 1/4 w.
R15	3R152-P221J	Composition: 220 ohms ±5%, 1/4 w.
R16	3R152-P301J	Composition: 300 ohms ±5%, 1/4 w.
R17	3R152-P510J	Composition: 51 ohms ±5%, 1/4 w.
R18	3R152-P821J	Composition: 820 ohms ±5%, 1/4 w.
R19	3R152-P103J	Composition: 10,000 ohms ±5%, 1/4 w.
R20	3R152-P510J	Composition: 51 ohms ±5%, 1/4 w.
R21	3R152-P152J	Composition: 1500 ohms ±5%, 1/4 w.
R22	3R152-P103J	Composition: 10,000 ohms ±5%, 1/4 w.
R23	3R152-P682J	Composition: 6800 ohms ±5%, 1/4 w.
R24 and R25	3R152-P100J	Composition: 10 ohms ±5%, 1/4 w.
R26	3R152-P301J	Composition: 300 ohms ±5%, 1/4 w.
R27	3R152-P682J	Composition: 6800 ohms ±5%, 1/4 w.
R28	3R152-P100J	Composition: 10 ohms ±5%, 1/4 w.
R29	3R152-P221J	Composition: 220 ohms ±5%, 1/4 w.
R30	3R152-P510J	Composition: 51 ohms ±5%, 1/4 w.
R31	3R77-P621J	Composition: 620 ohms ±5%, 1/2 w.
R32 and R33	3R152-P302J	Composition: 3000 ohms ±5%, 1/4 w.

SYMBOL	G-E PART NO	DESCRIPTION
R34	3R152-P151J	Composition: 150 ohms ±5%, 1/4 w.
R35	3R152-P100J	Composition: 10 ohms ±5%, 1/4 w.
R36	3R152-P510J	Composition: 51 ohms ±5%, 1/4 w.
R37	3R77-P621J	Composition: 620 ohms ±5%, 1/2 w.
R38 and R39	3R152-P302J	Composition: 3000 ohms ±5%, 1/4 w.
R41	3R152-P510J	Composition: 51 ohms ±5%, 1/4 w.
R42	3R152-P750J	Composition: 75 ohms ±5%, 1/4 w.
R43	3R152-P100J	Composition: 10 ohms ±5%, 1/4 w.
R44 and R45	3R152-P510J	Composition: 51 ohms ±5%, 1/4 w.
R46 and R47	3R77-P471J	Composition: 470 ohms ±5%, 1/2 w.
R48 thru R51	3R152-P562J	Composition: 5600 ohms ±5%, 1/4 w.
R52 and R53	3R152-P621J	Composition: 620 ohms ±5%, 1/4 w.
R54 and R55	3R152-P241J	Composition: 240 ohms ±5%, 1/4 w.
R56	5492251-P105	Variable, composition: 1000 ohms ±10%, 0.25 w; sim to Allen-Bradley Type F.
R57	19B209294-P269	Metal film: 5110 ohms ±1%, 1/8 w; sim to IRC Type CEA-TO.
R58	3R152-P431J	Composition: 430 ohms ±5%, 1/4 w.
R59 and R60	3R152-P510J	Composition: 51 ohms ±5%, 1/4 w.
R61	3R152-P162J	Composition: 1600 ohms ±5%, 1/4 w.
R62	3R152-P100J	Composition: 10 ohms ±5%, 1/4 w.
R63 and R64	3R152-P910J	Composition: 91 ohms ±5%, 1/4 w.
		- - - - - - - - - - THERMISTORS - - - - - - - - - -
RT1	5490828-P15	Thermistor: 1000 ohms ±5%, color code green; sim to Globar Type A0804B-7.
		- - - - - - - - - - TRANSFORMERS - - - - - - - - - -
T1 thru T10	19A101377-G3	Coil.
Z1	19A102247-P1	Includes CR3 and CR4 (19A115848-P1) matched pair.
		- - - - - - - - - - CAPACITORS - - - - - - - - - -
C1 thru C4	5493392-P7	Ceramic, feed-thru: .001 µf +100%-0%, 500 VDCW; sim to Allen Bradley Type FA5C.
C6	5490008-P43	Silver mica: 470 pf ±5%, 300 VDCW; sim to Electro Motive Type DM-15.
		- - - - - - - - - - TERMINALS - - - - - - - - - -
E24 and E25	4029868-P1	Terminal, feed thru: sim to Sealectro Corp FT-1000-DTUR.
		- - - - - - - - - - INDUCTORS - - - - - - - - - -
L1	7488079-P11	Choke, RF: 3.90 µh ±10%, 0.16 ohms DC res max; sim to Jeffers 4421-2.
		- - - - - - - JACKS AND RECEPTACLES - - - - - - -
J16	7776570-P18	Receptacle, right angle: coaxial, 500 v peak; Military UG-1098/U.
		- - - - - - - - - - RESISTORS - - - - - - - - - -
R1	3R152-P100K	Composition: 10 ohms ±10%, 1/4 w.

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